

Policy recommendations to uplift industrial production capacity in the new EU Member States

Smart Factories in new EU Member States Final Report

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Executive Summary

For the period 2021-2027 the European Commission foresees to invest €9.2 billion in the first ever Digital Europe programme for increasing the EU's international competitiveness through investing in the digital capacity of the European economy. For this new investment programme to succeed, a solid network of European Digital Innovation Hubs will be set up. In each European region there will be at least one European Digital Innovation Hub. The network will be built upon a wide variety of programmes to stimulate the creation and capacity building of Digital Innovation Hubs (DIHs), in particular with the assistance of the European Regional Development Funds and the Horizon 2020 programme. Coordination and Support Actions (e.g. I4MS, Smart Anything Everywhere, etc.), Interreg projects (KETGATE, S34Growth), initiatives under macro-regional strategies and the S3 thematic partnerships are experimenting with Digital Innovation Hubs' collaborations across Europe.

This **project focused on the creation of Digital Innovation Hubs' capacity in the new EU Member States**. The rationale for the project was to address the disproportion in the number of DIHs and maturity levels represented by DIHs between the EU13 and the EU15. The nature of the actions undertaken were twofold:

1. a training and mentoring programme focused only on DIHs from the EU13
2. an in-depth study of policy support measures for creating and supporting DIHs in the EU15 and a comparison with best practice in policy support measures in the EU13.

To enable the identification, assessment and recommendation to DIHs, a specific methodology was developed for Digital Innovation Hubs. This logical model helps in understanding basic elements involved in the functioning of DIHs and in their potential interactions. This model is based on inputs, activities, outputs and outcomes.

The **training and mentoring programme** constituted the major part of the project. It combined different elements and methods to enhance DIHs' experience and maximise the impact of the programme curriculum. The training resources were grouped into eight knowledge areas, each relating to a package of in-country training and mentoring, and aligned to the specific requirements of a section of the final business plan to be developed by each DIH. The trainings were delivered using digital channels and webinars and were followed up with live question and answer sessions.

Another key element of the programme was the support offered by dedicated **mentors**. The primary role of the mentor was to deliver 1:1 training, discussing elements of the training packages that their individual learner required support in, and helping the hub in the completion of the set exercises and templates. The mentors were responsible for ensuring each DIH had the necessary grounding in the training topics taught, to be able to complete the exercises.

The programme also offered a **peer-learning component**, which promoted the exchange and sharing of knowledge, experience and practices among the selected DIHs. It was particularly important for DIHs in the early stage of development to learn from DIHs, which have already gained significant results. Several online best practice exchange sessions and face-to-face networking meetings were organised, which exposed DIHs to key stakeholders of the innovation ecosystem.

In addition, an analysis of the **state-of-play was carried out in the regions where 34 selected DIHs are located**. Each regional analysis follows the same structure and aims at providing comparable information and data. This enables interregional comparative analysis. The main points of each analysis are:

- Demand-side barriers regarding the implementation of digital transformation,
- Structural macro-economic barriers,
- Sources of available public finance for innovation projects,
- Positive and negative examples of initiatives undertaken in the region.

A set of **successful support measures was identified in the EU15** to help Digital Innovation Hubs in the less digitised regions. There was a clear trend in the replication of measures within the EU15 in skilling measures, digital enablers and funding measures, and voucher systems

At European level, the European Union has taken three **upskilling and re-skilling initiatives**¹: the Digital Skills and Jobs Coalition, the New Skills Agenda, and the Digital Opportunity Traineeship. These are all initiatives to tackle the shortage of digital skills and are set up to support, to complement or to boost national and regional skills initiatives in Member States.

In the European market, a mismatch exists between demand and supply of essential digital capacities. To tackle the mismatch, **digital enablers** are implemented at national and regional level in Europe. The proposed "Digital Europe"² programme will provide the answer at European level, which will also address the need to increase advanced digital skills in the EU's workforce.

Innovation vouchers are used as a policy measure across Member States and are seen as a well-established tool of innovation policies³. However, their effectiveness in stimulating the adoption of new technologies is hardly documented⁴. Due to the need to draw the design of the voucher schemes to local SME needs, the voucher schemes exist mostly at national and regional level.

The development of **financial instruments** at national and regional level is enabled by the digitisation priorities in the European Structural and Investment Funds. At European level the InnovFin facility of the European Investment Bank is a financial instrument which has the digital economy as one of its priorities, under which it also finances directly Digital Innovation Hubs.

The lessons learned from best practices in the EU15 and the experience in working with the DIHs in the EU13, lead to the following **recommendations**:

On the European level, networking between DIHs can bridge the experience gap for DIHs in the EU13. Regional cooperation between regions in the EU15 and the EU13 can strengthen the replication of successful policy measures. The regional level is the best level to raise awareness of digitisation challenges for SMEs. New policy instruments are

¹ Digital Innovation Hubs Working Group, Report from the Working Group Meeting on Digital Skills, July 2018, DG CONNECT, <https://ec.europa.eu/digital-single-market/en/news/report-fourth-meeting-working-group-digital-innovation-hubs>

² European Commission - Press release, EU budget: Commission proposes EUR 9.2 billion investment in first ever digital programme, Brussels, 6 June 2018, http://europa.eu/rapid/press-release_IP-18-4043_en.htm

³ Lessons from a Decade of Innovation Policy, Final Report, European Union, June 2013

⁴ Paola Valbonesi, Federico Biagi; Incentivising Innovation and Adoption of ICT: ICT Innovation Voucher Programmes; JRC Science for Policy Report EUR 28293 EN; doi:10.2791/225970

needed to ensure that Digital Innovation Hubs in all European regions become a reality, which is a sine qua non for maximising the outreach to European SMEs.

On the national level the national digitisation policies have to be in place, which have to be complemented by national initiatives to support Digital Innovation Hubs. These initiatives have to be embedded in the national innovation policy, supported by a broad collation of national stakeholders. To make the SMEs responsive, an incentive programme has to be in place, complemented by platforms to exchange information and experiences. The best funding for these measures is a combination of public and private financial sources.

On the regional level, actors need clear mandates from the national governments to roll out the national strategy at regional level. Regional actors are able to set-up peer-to-peer networks to motivate companies to adopt digitisation strategies and win the trust needed by companies. Upskilling is an important part of the digitisation agenda and regional actors are well equipped to consider the affected individual employees. These employees need upskilling in technical as well as soft skills to help them address the digitisation challenges for the next decade.

The report gives a set of clear recommendations on national and regional levels. The most important issues raised in the report with regard to national initiatives are as follows:

- **Adoption of a national digitisation policy:** All EU15 have a digitisation policy in place, where the EU13 are in various stages of digitisation-policy development. Many countries already enforced proper policies, but with a varying degree of success. Some of them are still working on the policy development.
- **National Initiatives for Digital Innovation Hubs are a game changer:** EU13 should follow good practices from EU15, like in Germany (Industry 4.0 Competence Centres) or Netherlands (creation of field labs financed through private funding).
- **Alignment of the innovation-policy support measures with Digital Innovation Hubs needs:** An example of the Greek Digital Innovation Hub ARIC demonstrates that a Digital Innovation Hub can thrive well, if it can connect and work closely together with innovation actors. Those include clusters, new market enablers, innovation infusers, business incubators, educational bodies, internationalisation enablers and access-to-finance providers.
- **Cooperation between various ministries, employment organisations and trade unions should be possible:** Case studies of Comiflex (Sweden) and Skills Bridge (Luxembourg) show that these policy measures can only advance with the support of a tripartite agreement.
- **SMEs need incentives to convince them to work on digitisation:** In Italy, vouchers for digitisation were requested by 92,000 SMEs of which only 10,000 can be honoured. This shows there is a real need for funding support and that authorities need to manage the demand.
- **Platforms for the exchange of information and experiences are necessary to reach SMEs:** Digital platforms are necessary tools to reach out to as many SMEs as possible. These platforms need to be client friendly and easy to use.
- **Communication and dissemination are essential to keep the interest high:** Awareness-raising campaigns together with an available helpdesk build trust with SMEs and improve the impact of digitisation measures.

- **A dedicated implementation body has to be in charge of the digitisation policy:** In France a dedicated SME Agency, JESSICA, is in charge of the implementation of digitisation measures and has been successful for many years.
- **A mixture of private and public funding improves the possible impact of a digitisation measure:** In the EU13 there are very few examples of privately and publicly co-financed Digital Innovation Hubs, whereas there are plenty of evidence that such cooperation gives great results (example of Fieldlabs in Netherlands).
- **Ensure the national digitisation policy has a strategy and a realistic action plan:** The development of a national digitisation plan should start with awareness raising campaign and should early on determine main actors to be involved in advising companies.
- **Set up an information and communication platform:** The main stakeholders need to meet physically to agree on a common agenda. Local meetings and a digital platform should reach the targeted companies.
- **Set up a public-private partnership, which will ensure funding and support for Digital Innovation Hubs:** In Germany, twelve Digital Hubs are mandated to form strategic alliances with private actors at regional level. These actors can be industry associations, clusters or individual companies.

On the regional level, the report demonstrates the following findings:

- **Regions have to be mandated by the national government to be active in digitisation policy measures:** In Germany the federal states play an important role in rolling out the Industry 4.0 policy and the national government mandated them to do so.
- **Peer-to-peer networks are essential to learn from best practices and to motivate companies in adopting digitisation strategies:** In Belgium the so-called ambassadors, which represent leading successful cases of digitalisation in business, lay a crucial role in the Made Different initiative.
- **Inclusion of regional stakeholders in the digitalisation policy to create the trust needed by companies:** The Austrian SME Digital Funding Program engages regional organisations and advisors to roll out the programme at regional level, which can be a good example for EU13.
- **Policy measures need to take into account individual employees affected by the digital transformation:** In the Luxembourgish initiative Skills Bridge, the role of the individual employee was recognised as a key success factor for the implementation of the pilot programme.
- **Regional specificities have to be taken into account for regional measures:** In preparation of the German Digitisation and Innovation vouchers, the needs of SMEs were mapped, which is continued to be monitored during implementation.

Résumé Opérationnel

Pour la période 2021-2027, la Commission Européenne prévoit d'investir 9,2 milliards d'euros dans le premier véritable programme pour une Europe Numérique afin d'améliorer la compétitivité de l'UE au niveau international en investissant dans la capacité numérique de l'économie européenne. Pour que ce nouveau programme d'investissement réussisse, un solide réseau de Pôles Européens d'Innovation Numérique sera créé. Dans chaque région d'Europe il y aura au moins un Pôle Européen d'Innovation Numérique. Ce réseau sera constitué à partir d'une grande diversité de programmes destinés à stimuler la création et le renforcement des capacités des Pôles d'Innovation Numérique (Digital Innovation Hubs (DIHs)), notamment avec le soutien des Fonds Européens de Développement Régional et du Programme Horizon 2020. Les Actions de Coordination et de Soutien (par ex. I4MS, Smart Anything Everywhere, etc.), les projets Interreg (KETGATE, S34Growth), les initiatives de stratégie macro-régionale et les partenariats thématiques S3 explorent la collaboration des Pôles d'Innovation Numérique dans toute l'Europe.

Ce **projet s'est concentré sur la création de capacités des Pôles d'Innovation Numérique dans les Nouveaux États Membres de l'UE**. La raison d'être du projet était de répondre à la disproportion en ce qui concerne le nombre de DIH et les niveaux de maturité présentés par les différents DIH entre l'UE-13 (les 13 États entrés dans l'UE en 2004) et l'UE-15 (États membres de l'UE avant l'élargissement de 2004). La nature des actions a été double :

3. un programme de formation et de tutorat concentré uniquement sur les DIH de l'UE-13, et
4. une étude approfondie des mesures de la politique de soutien pour la création et le soutien des DIH dans l'UE-15 et une comparaison avec les meilleures pratiques des mesures de la politique de soutien dans l'UE-13.

Pour permettre l'identification et l'évaluation des DIHs ainsi que les recommandations pour les DIHs mêmes, une méthodologie spécifique a été développée pour les Pôles d'Innovation Numérique. Ce modèle logique aide à comprendre les éléments de base impliqués dans le fonctionnement des DIH et leurs interactions potentielles. Ce modèle est basé sur les données d'entrée, les activités, les données de sortie et les résultats.

Le **programme de formation et de tutorat** a constitué la partie principale du projet. Il a combiné différents éléments et méthodes pour perfectionner l'expérience des DIHs et maximiser l'impact du programme. Les ressources de formation ont été regroupées en huit domaines de connaissance, chacun étant lié avec un paquet de formation et tutorat dans les pays et aligné aux prérequis spécifiques d'une section du *business plan* final qui doit être développé par chaque DIH. Les formations ont été distribuées utilisant des canaux numériques et de webinaires suivis par des sessions de questions et réponses.

Un autre élément clé du programme a été le soutien fourni par des **tuteurs** dédiés. Le rôle premier du tuteur était de fournir des formations individuelles, de discuter les éléments des paquets de formation pour lesquels les DIHs ont eu besoin de soutien ainsi que d'aider le pôle à compléter l'ensemble d'exercices et de modèles. Les tuteurs avaient pour mission de s'assurer que chaque DIH disposait des connaissances de base nécessaires sur les thèmes abordés dans la formation afin de bien mener les exercices.

Le programme a inclus une **composante d'apprentissage au-pair** qui promouvait l'échange et le partage de savoir, d'expériences et de pratiques parmi les DIH choisis.

Ceci a été particulièrement important pour les DIHs qui étaient à une étape initiale de développement pour apprendre des DIHs qui avaient déjà acquis des résultats notables. Plusieurs sessions d'échange de best practices et de rencontre vis-à-vis ont été organisées, ce qui a permis aux DIH d'être en contact avec des partis cruciaux de l'écosystème de l'innovation.

De plus, une analyse de l'état des choses a été menée dans les régions où les 34 DIH choisis sont localisés. Chaque analyse régionale reprend la même structure et les mêmes objectifs de fournir des informations et des données comparables. Ceci permet d'effectuer une analyse comparative interrégionale. Les principaux points de chaque analyse sont :

- les obstacles du point de vue de la demande en ce qui concerne l'implémentation de la révolution numérique,
- les barrières structurelles macro-économiques,
- les sources de financement public disponibles pour les projets d'innovations,
- exemples positifs et négatifs d'initiatives en place dans la région.

Un ensemble de **mesures de soutien qui ont fait la preuve de leur réussite ont été identifiées dans l'UE-15** pour aider les Pôles d'Innovation Numérique dans les régions les moins numérisées. Il y a eu une tendance claire à reproduire les mesures dans l'UE-15 en ce qui concerne les compétences, les facilitateurs numériques et le financement et des systèmes de chèques (*vouchers*).

Au niveau européen, l'Union Européenne a créé trois initiatives dans le domaine du **perfectionnement et de la réorientation des compétences**⁵ : la Coalition pour les Compétences et les Emplois dans le Numérique, l'Agenda des Nouvelles Compétences, la Valorisation des Compétences Numériques (Digital Skills and Jobs Coalition, the New Skills Agenda, and the Digital Opportunity Traineeship). Toutes ces initiatives doivent aborder la pénurie de compétences numériques afin de compléter ou de stimuler les initiatives de compétences nationales et régionales dans les États Membres.

Sur le marché européen, il existe une incompatibilité entre la demande et l'offre de capacités numériques essentielles. Pour aborder cette incompatibilité, des **facilitateurs numériques (*digital enablers*)** sont introduits au niveau national et régional en Europe. Le programme « Europe Numérique » ("*Digital Europe*"⁶) proposé fournira la réponse au niveau européen et répondra également au besoin de faire progresser les compétences numériques avancées de la main-d'œuvre dans l'UE.

Les **chèques-Innovation (*innovation vouchers*)** sont utilisés comme une mesure de politique au niveau des États Membres et ils sont perçus également comme des outils bien établis des politiques d'innovation ⁷. Toutefois, leur efficacité à stimuler l'adoption de nouvelles technologies est assez peu documentée⁸. Compte tenu de la nécessité d'adapter le modèle du chèque aux PME locales, les modèles de chèques existent principalement au niveau national et régional.

⁵ Digital Innovation Hubs Working Group, Report from the Working Group Meeting on Digital Skills, July 2018, DG CONNECT, <https://ec.europa.eu/digital-single-market/en/news/report-fourth-meeting-working-group-digital-innovation-hubs>

⁶ European Commission - Press release, EU budget: Commission proposes EUR 9.2 billion investment in first ever digital programme, Brussels, 6 June 2018, http://europa.eu/rapid/press-release_IP-18-4043_en.htm

⁷ Lessons from a Decade of Innovation Policy, Final Report, European Union, June 2013

⁸ Paola Valbonesi, Federico Biagi; Incentivising Innovation and Adoption of ICT: ICT Innovation Voucher Programmes; JRC Science for Policy Report EUR 28293 EN; doi:10.2791/225970

Le développement des **instruments financiers** à un niveau national et régional est rendu possible par les priorités de numérisation dans les Fonds Structurel et d'Investissement européens. Au niveau européen, le dispositif innovFin de la Banque Européenne d'Investissement est un instrument financier qui fait de l'économie numérique une de ses priorités, ce qui lui permet également de financer directement les Pôles d'Innovation Numérique.

La leçon qui a pu être tirée des meilleures pratiques de l'UE-15 et l'expérience de travail avec les DIHs dans l'UE-13 aboutissent aux **recommandations suivantes** :

Au niveau européen, l'interconnexion des DIHs peut combler le différentiel d'expérience pour les DIHs de l'EU-13. La coopération régionale entre les régions de l'UE-15 et de l'UE-13 peut renforcer la reproduction de mesures politiques qui ont montré d'être efficaces. Le niveau régional est le niveau le meilleur pour faire prendre conscience des défis de la numérisation pour les PME. De nouveaux instruments politiques sont nécessaires pour que les Pôles d'Innovation Numérique deviennent une réalité, ce qui est une condition *sine qua non* du rayonnement des PME européennes.

Au niveau national, les politiques de numérisation doivent être mises en place et elles doivent être complétées par des initiatives nationales de soutien aux Pôles d'innovation Numérique. Ces initiatives doivent être intégrées dans la politique nationale d'innovation, soutenue par une large participation de partis nationaux. Pour que les PME soient réactives, un programme de motivation doit être mis en place et il doit être complété par des plateformes d'échange d'informations et d'expériences. Le meilleur financement de ce genre de mesures est une combinaison de sources financière à la fois publiques et privées.

Au niveau régional, les acteurs ont besoin d'avoir des mandats clairs de la part des gouvernements pour déployer la stratégie nationale au niveau régional. Les acteurs régionaux sont capables de mettre en place des réseaux *peer-to-peer* pour encourager les entreprises à adopter des stratégies de numérisation et pour acquérir la confiance nécessaire des entreprises. La perfection des compétences est une partie importante de l'agenda de numérisation et les acteurs régionaux sont bien équipés pour prendre en compte les employés individuels concernés. Ces employés ont besoin de se perfectionner aussi bien au niveau technique qu'au niveau personnel pour relever les défis de la numérisation au cours de la décennie à venir.

Le rapport donne un ensemble de recommandations claires, tant au niveau national qu'au niveau régional. Les questions les plus importantes qui sont abordées dans le rapport, en prenant en compte les initiatives nationales, sont les suivantes :

- **l'adoption d'une politique nationale de numérisation** : tous les pays de l'UE-15 ont une politique de numérisation, alors que les pays de l'UE-13 se placent à différents niveaux en termes de politique de numérisation. De nombreux pays ont déjà appliqué leurs propres politiques avec un degré de succès très variable. Certains d'entre eux continuent à travailler sur leur politique de développement ;
- **les initiatives pour les Pôles d'Innovation Numérique changent la donne** : l'UE-13 doit suivre les bonnes pratiques de l'UE-15, comme en Allemagne (Centres de Compétence d'Industrie 4.0) ou aux Pays-Bas (création de laboratoires de terrain financés par des fonds privés) ;
- **l'alignement des mesures de soutien à la politique d'innovation sur les besoins des Pôles d'Innovation Numérique** : l'exemple du Pôle d'Innovation Numérique grec ARIC fait la preuve qu'un Pôle d'Innovation Numérique peut être florissant s'il a la possibilité de se connecter et travailler étroitement avec des acteurs

de l'innovation. Ceux-ci incluent les clusters, les facilitateurs des nouveaux marchés, les diffuseurs d'innovation, les incubateurs d'entreprises, les corps enseignants, les facilitateurs d'internationalisation et les fournisseurs d'accès aux finances ;

- **la coopération entre différents ministres, organisation du travail et syndicats doit être possible** : les cas d'étude de Comiflex (Suède) et de Skills Bridge (Luxembourg) montrent que ces mesures politiques ne peuvent progresser que dans le cadre d'un accord tripartite.
- **les PME ont besoin de motivations pour être convaincues de travailler sur la numérisation** : en Italie, les chèques pour la numérisation ont été demandés par 92 000 PME dont seulement 10 000 peuvent avoir une réponse favorable. Ceci montre qu'il y a un véritable besoin de soutien financier et que les autorités doivent gérer cette demande.
- **des plateformes pour l'échange d'informations et d'expériences sont nécessaires pour atteindre les PME** : les plateformes numériques sont des outils nécessaires pour atteindre autant de PME que possible. Ces plateformes doivent être conviviales et faciles à utiliser.
- **la communication et la diffusion sont essentiels pour maintenir un haut niveau d'intérêt** : les campagnes de sensibilisation associées à un support technique accessible construisent de la confiance avec les PME pour améliorer l'impact des mesures de numérisation.
- **un organisme dédié à la mise en œuvre doit être chargé de la politique de numérisation** : en France, une Agence dédiée aux PME, JESSICA, est en charge de la mise en œuvre des mesures de numérisation et elle réussit dans son domaine depuis de nombreuses années.
- **une association de financement privé et public améliore l'impact potentiel d'une mesure de numérisation** : dans l'UE-13, il y a très peu d'exemples de Pôles d'Innovation Numérique avec un cofinancement public-privé, alors qu'il y a beaucoup d'exemples de succès de ce type de coopération (exemple de Fieldlabs aux Pays-Bas).
- **Il faut s'assurer que la politique de numérisation ait une stratégie et un plan d'action réaliste** : le développement d'un plan national de numérisation doit commencer par une campagne de sensibilisation et doit définir dès le début les principaux acteurs impliqués des les campagnes de conseil.
- **Il convient de mettre en place une plateforme d'informations et de communication** : les principaux intervenants ont besoin de se rencontrer physiquement pour convenir à un agenda commun. Les réunions locales sur une plateforme numérique doivent atteindre les entreprises ciblées.
- **Il convient de mettre en place un partenariat public-privé qui permettra d'assurer un soutien aux Pôles d'Innovation Numérique** : en Allemagne 12 Pôles d'Innovation Numériques ont reçu des demandes pour constituer des alliances stratégiques avec des acteurs privés à un niveau régional. Ces acteurs peuvent être des associations industrielles, des clusters ou des entreprises individuelles.

Au niveau régional, le rapport livre les conclusions suivantes :

- **les régions doivent être encouragées par le gouvernement national à être actives en ce qui concerne les mesures de politique de numérisation** : en Allemagne, les länder jouent un rôle important dans la mise en œuvre de la politique d'industrie 4.0 et le gouvernement peut leur demander d'agir en ce sens ;

- **les réseaux *peer-to-peer* sont essentiels pour apprendre des bonnes pratiques et pour motiver les entreprises à adopter des stratégies de numérisation :** en Belgique les « Ambassadeurs » qui représentent des cas de numérisation emblématiques jouent un rôle crucial dans l'initiative *Make Different*.
- **Il convient d'inclure les partis régionaux dans la politique de numérisation pour créer la confiance dont les entreprises ont besoin :** le programme autrichien de Financement Numérique des PME implique des organisations régionales et des conseillers pour mettre en œuvre le programme à un niveau régional, ce qui peut être un bon exemple pour l'UE-13.
- **les mesures politiques doivent prendre en considération les employés individuels touchés par la révolution numérique :** dans l'initiative luxembourgeoise Skills Bridge, le rôle de l'employé individuel a été reconnu comme un facteur essentiel de l'implémentation du programme pilote.
- **les spécificités régionales doivent être prises en compte pour les mesures régionales :** pour la préparation des chèques Numérisation et Innovation allemands, les besoins des PME ont été cartographiés, ce qui a suivi au cours de la mise en œuvre.
- **Pour les initiatives de perfectionnement et de réorientation des compétences il est nécessaire de combiner les compétences techniques et personnelles :** dans l'initiative luxembourgeoise Skills Bridge, compte tenu de la nécessité de perfectionner les nouvelles compétences à l'ère du numérique, le besoin de développer les compétences personnelles au delà des compétences techniques est apparu comme évident.

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1 Introduction

1.1 Setting the scene

The European Commission launched on 19 April 2016 the first industry-related initiative of the Digital Single Market – Digitalising European Industry (DEI). Capitalising on and complementing various national and regional initiatives for digitising industry, the Commission's activities trigger further investments in the digitisation of industry. One of the more important pillars of the DEI effort is the activity to develop a network of Digital Innovation Hubs (DIH).

In the context of the DEI initiative, its Working Group 1 (WG1) started its activities in October 2016. WG1 focused on DIHs as a means of supporting businesses, and notably SMEs and non-tech industry, in their digital transformation under the DEI initiative. It brought together stakeholders with interests in running and operating DIHs as well as potential beneficiaries in industry. Furthermore, again in the context of the DEI initiative, a DIHs Catalogue was created containing comprehensive information on the digital innovation hubs in Europe to give information on the competences that could address SMEs' needs in order to digitise their products, processes and services. The third report⁹ of WG1 provides a non-exhaustive, although valuable, list of ongoing initiatives and projects at EU and national level. The same report also takes stock of discussions regarding a definition of DIH, as well as their distinctive features.

A DIH is defined by the Working Group 1 "Digital Innovation Hubs: Mainstreaming Digital Innovation Across All Sectors" as a support facility that helps companies become more competitive by improving their business/production processes as well as products and services by means of digital technology. DIHs act as a one-stop-shop, serving companies within their local region and beyond to digitalise their business. They help customers address their challenges in a business focused way and with a common service model, offering services that would not be readily accessible elsewhere.

Some similarities can be drawn between DIHs and other business-support facilities such as business incubators, competency and excellency centres. However, the DIH are distinct due to the fact that DIH brings together all regional actors that are engaged in knowledge and technology transfer and capacity building. Those are universities, research centres, cluster organisations, industry associations, incubators, accelerators as well as regional and local authorities. This coordination is undertaken with the view of developing a comprehensive set of services to support digital transformation process of companies in the region.

For the purpose of developing a detailed methodology for identifying, assessing and recommending DIHs we developed a logic model for DIH as a concept which helps to understand basic elements involved and potential interactions within the system. We employed this simple model for verifying whether the approach we adopted matches the general concept.

⁹ https://ec.europa.eu/futurium/en/system/files/ged/dei_working_group1_report_april_2017.pdf

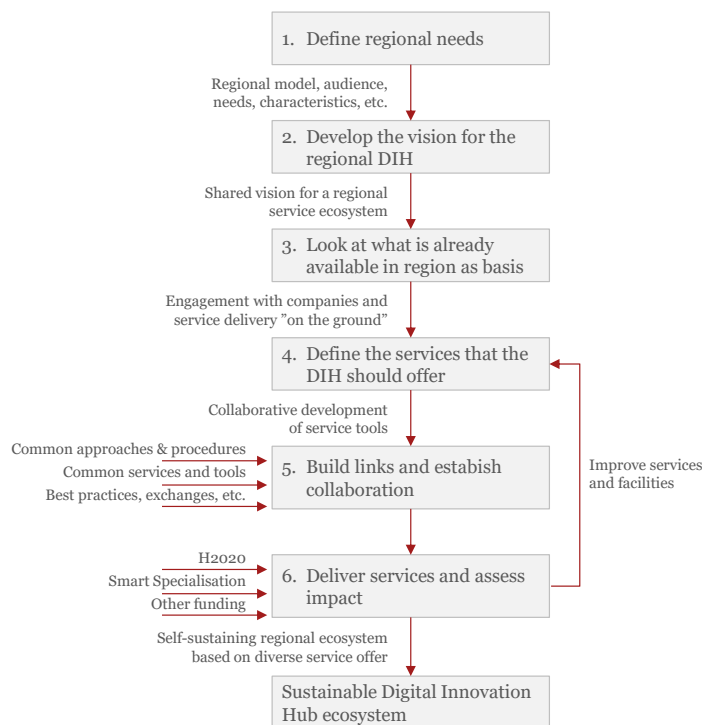
Table 1: Basic Logic Model of DIH¹⁰

Inputs	Activities	Outputs	Outcomes
Motivated target groups: Industry associations, single enterprises currently advising on using digital technologies, clusters of enterprises, universities, competency centres, business incubators, public administration;	Access to Specialist Expertise and Infrastructure Brokering/matchmaking Awareness Creation around Digital Technologies Innovation Scouting Digital Maturity Assessment Visioning and Strategy Development for Businesses: <ul style="list-style-type: none"> • Mentoring • Training • Access to Funding and Investor Readiness Services 	Number of DIH users; Number of referrals to ICT companies and other service providers; Percentage of users with successful digitisation activities; Percentage of users returning and/or referred on for other services; Number of events and participation in events; Number of collaborations and cross-border linkages; Amount of training provided and increases in digital skills; Amount of external funding secured for client companies.	Increased competitiveness of regional industry by introducing digital technologies to strengthen products services. Impact could be measured using econometric measures, such as increased awareness, enhanced competitiveness and assessment of digital maturity. Examples include: increase in a company's market share; creating value via new markets and business models; establishing new value chains; increasing the turnover ratio between services and products; quantifying cost reductions of services and resource optimisation due to digitisation; number of patents and other IP protections; number of people trained in digital skills. Systematic monitoring should not be complicated and expensive. While certain performance metrics will certainly be needed, user-rated approaches and social media should also be used. Users should be able to share their experiences of hub providers through a 'TripAdvisor-type' engine so as to create a user-rated ecosystem for digitisation services. Social media should also be used as a means of evaluating hubs' performance.

Particularly valuable is the work devoted to developing a Blueprint for a Digital Innovation Hub offering a roadmap for any national or regional authority or innovation intermediary wishing to establish a DIH or expand an existing initiative.

¹⁰ Based on Final Report of Roundtable on Digitising European Industry: Working Group 1 - Digital Innovation Hubs: Mainstreaming Digital Innovation Across All Sectors, June 2017;

Figure 1: A Blueprint for a Digital Innovation Hub



Source: Roundtable on Digitising European Industry: Working Group (WG) 1 – Digital Innovation Hubs

WG1 also identified eight priority actions necessary to take the initiative forward, listed here below

- Recommendation 1: Develop the information base
- Recommendation 2: Share experiences across Member States and regions
- Recommendation 3: Ensure high-level political support within Member States and regions
- Recommendation 4: Utilise H2020 investments to enhance EU added value
- Recommendation 5: Launch pilot actions aimed at developing synergies and building larger initiatives
- Recommendation 6: Intensify outreach to regions with few DIHs
- Recommendation 7: Mobilise investment by the Member States
- Recommendation 8: Activate the European network of Digital Innovation Hubs.

The report and its findings provided fundamental support to the discussion in the EU on the support to and the role of DIHs in benefiting from the digitalisation of the industry in Europe. Another crucial element which laid grounds to this report originated in the European Parliament. The then Member of the European Parliament, Victor Negrescu, initiated a dedicate support action to DIHs from the new EU Member States. The reason for such an initiative was a gap between DIHs from Western and Eastern Europe. It was estimated that only about 1 in 8 DIHs in the EU was operating in one of 13 new EU Member States.

In order to address this disproportion in the number of DIHs and maturity levels represented by DIHs between EU13 and EU15, the European Parliament with the European Commission (DG Connect) decided to launch a training and mentoring programme focused only on DIHs from the EU13. The programme was commissioned via an open tendering procedure in form of a service contract.

The objective of the service contract was to support the European Commission in implementing DIHs across EU13 countries. Successful implementation of this initiative aimed at setting the basis for ensuring the long term competitiveness of SMEs in new Member States. The project supported the Commission by:

- Identifying Institutions that can potentially take on the role of a DIH across the 13 new EU Member States
- Providing leading edge methodology to select the most appropriate DIHs for implementation, based on a set of criteria including qualitative and quantitative performance criteria for evaluation
- Building the capacity of the chosen DIHs by organising workshops aimed towards mentoring and coaching activities
- Based on the experience and information gained carrying out the above-listed key actions as well as through EU13 and EU-wide research on best practices and current status of initiatives to uplift industrial production capacity, presenting the state of play and develop clear and targeted policy recommendations for improvement.

The project represents one of the key initiatives for the uptake of digital technologies by the SMEs focused on industrial manufacturing in the 13 new Member States. As digital technologies and digitisation are rapidly disrupting current business models and changing the way companies operate, it is crucial that the SMEs follow this trend that has been set by the European high tech companies. DIH represents the vehicle that would give all companies, regardless of industry or size, understanding the opportunities that the digital technologies represent while facilitating access to actually applying these technologies to their products and business models.

Table 2: Tasks and activities of the Project

Tasks	Activities
Task 1: Demonstration activity of supporting establishment of at least 30 new Regional Digital Innovation Hubs in at least 8 different new Member States	<ul style="list-style-type: none"> • Preparation of the methodology to identify potential DIHs in regions of the new EU Member States • Selection of at least 30 DIHs based on the methodology • Dissemination of the initiative by organising at least 8 informal events • Provision of manuals and background information • Provision of training and workshops on business development skills and on sustainable activities (including identification of funding opportunities) • Organisation of regional workshop for engaging the local ecosystem and obtaining a better understanding of their needs and possible barriers

- Feasibility studies for at least 30 regional Digital Innovation Hubs in new Members States and linking them to the existing network of innovation
- Support to the development of a concrete action plan, including a business case for the establishment of a DIH in the region

Task 2: Policy recommendations to uplift industrial production capacity in the new EU Member States

- Analysis of the state-of-play in the selected regions compared to other EU regions developing a compelling vision, methodology and criteria for improving competitiveness
-
- Identification, assessment and potential support measures for exploiting the industrial potential in the selected regions and the scope for their extension
-

1.2 Overview of the approach

The two tasks of the Project are tightly interrelated among them. The team implementing the project provided an integrated approach with explicit logical links between the four sub-tasks, aimed at answering the two key objectives:

Task 1. Demonstration activity of supporting the establishment of at least 30 new Regional Digital Innovation Hubs in at least 8 different new EU member states

Task 1 has two main sub-components that are interrelated and determine the course of work for this task. The first sub-component is the identification and selection of DIHs in the EU13. The results of this task give the regional focus to sub-task 2 in determining where the demonstration activity will be performed.

The regional selection of DIHs determine the relevant I4MS or SAE services, training support and materials that are applicable for the uptake of the companies in the selected regions.

Task 1 also enables reaching out to the EU13 and wider Smart factories and innovation communities, which assist in providing feedback and valuable inputs across all the activities of the Assignment through workshops, meetings and existing studies and research. It also provides valuable insight for Task 2.

Task 2. Policy recommendations to uplift industrial production capacity in the new EU Member States

Task 2 includes the preparation the below report containing an analysis of the state-of-play in the selected regions from the new EU Member States compared to other EU regions.

The analysis was prepared based on the methodology assuring comparability among regions and includes a study meant to underline compelling vision and criteria for competitiveness improvement of the selected regions. The analysis is based on a top down approach, which leads to a broad analysis of the market situation in the country and in its key regions, of its investment needs, as well as identifying and assessing

support measures for exploiting the industrial potential in selected regions and the scope of its expansion.

The team also appreciated the significance of a bottom-up approach. Therefore, the team included elements of this approach to the study, e.g. by carrying out a needs assessment exercise. Information regarding expectations and needs of stakeholders was collected via semi-structured interviews, participation in relevant events (at EU, national and regional levels), and via an online survey. Data obtained through those channels was analysed and then synthesised. Finally, findings support development of policy recommendations. The policy recommendations target European Commission Services, EU Member States, regions, as well as key industry players, including specific types of policy initiatives and the ways of creating a higher level of uptake of digital technologies for EU13 SMEs and non-high tech industries in general.

2 Analysis of the state-of-play of industrial production capacity in the selected regions

2.1 State of play

In accordance with the tender specification the report and state-of-play analysis focus on regions of the European Union, which host DIHs selected to participate in the project. A region is understood for the purpose of this study as the second level of Nomenclature of Territorial Units for Statistics, so called NUTS-2. The Steering Committee of the project selected 34 DIHs from 13 EU Member States. Due to the fact that some of the selected DIHs come from the same regions, the analysis covers less than 34 regions.

Each regional state-of-play analysis follows the same structure and aims at providing comparable information and data. This shall enable interregional comparative analysis. The main points covered by each analysis are as follows:

- Demand-side barriers regarding the implementation of digital transformation
- Structural macro-economic barriers
- Sources of available public finance for innovation projects
- Sources of available public finance for innovation projects
- Positive and negative examples of initiatives undertaken in the region.

Table 2. DIHs participating in the Smart Factories in the new EU Member States project broken down by country and city

Country	City	DIH Name
Bulgaria	Sofia	Bulgarian Innovation and Technology Hub (Bulgarian DigiTech 4.0)
	Sofia	InnoCenter Bulgaria
	Varna	InnoSmartVarna (ISV)
Croatia	Bjelovar	hub.in Bjelovar
	Rijeka	Digital Partnership Centre (DIGIPARC)
	Zagreb	Digital Croatia Hub (DigiCro)
Cyprus	Nicosia	Cyprus Digital Innovation Hub (CyDI-Hub)
Czech Republic	České Budějovice	Jihočeský vědeckotechnický park, a.s. - Technologické centrum Písek s.r.o. (Member of CEEInno Platform)
	Prague	Digital Innovation Hub - National Centre for Industry 4.0 (DIH NCP4.0)
Estonia	Tartu	University of Tartu Digital Innovation Hub, DIH Tartu
Hungary	Budapest	innomine Digital Innovation Hub
	Kecskemét	Digital Innovation Hub of Kecskemét, Kecskemét Digital

Country	City	DIH Name
	Szombathely	AMLab
Latvia	Riga	Riga IT Demo Centre/ Latvian IT Cluster
Lithuania	Vilnius	Advanced Manufacturing Digital Innovation Hub
		Sunrise Valley Digital Innovation Hub (SV DIH)
Malta	Floriana	Malta – Digital Innovation Hub (M-DIH)
Poland	Gdańsk	3Hub – Pomeranian Digital Innovation Hub
	Katowice	Silesia Competence Centre Industry 4.0 (SCCI 4.0)
	Krakow	KTP Digital Innovation Hub (KTP DIH)
	Kraków	CYBERSEC HUB
	Otwock	Digital Innovation Hub Swierk (DIHS)
	Poznań	HPC4Poland
	Toruń	IoT North Poland HuB (IoTNP)
	Warsaw	PIAP DIH
Romania	Brasov	Cluster for Innovation and TechnologyCY6
	Bucharest	Digital Innovation Hub for Mechatronics – MECHATREC
	Cluj-Napoca	Transilvania iHUB 4.0
	Constanta	Constanta Innovation Hub (CiTyInnoHub)
	Timisoara	Timisoara's Digital open Smart Solution (TimDiOss)
Slovakia	Bratislava	University Technology Incubator
	Prešov	Institute of Technology "Jozef Murgaš" (IT - JM)
	Žilina	Zilina Innovation & Technology Hub (ZINTECH)
Slovenia	Ljubljana	Digital Innovation Hub Slovenia (DIHS)

2.2 State of play of each region

2.2.1 Bulgaria

2.2.1.1 Southwestern Region

The Southwestern region has boundaries with three countries - Greece to the south, and Serbia and the Republic of Macedonia to the west. It is Bulgaria's second region by size with an area of 20,306 square meters. Important national roads as well as three International Transport Corridors pass through the region, which makes it a strategic crossroad. The Southwestern region is comprised of 5 administrative districts – Sofia city, Sofia region, Pernik, Kiustendil and Blagoevgrad, and includes

52 municipalities in total and a population of 2,108,394 people. The dominant industry is the service sector, which continues to expand at the expense of shrinking sectors such as production and agriculture. Due to the favourable natural resources, the timber industry is highly developed. The region and the city of Sofia were ranked among the top 10 best performing cities in Europe in the Milken Institute report "Best-Performing Cities (BPC)". High-tech services, which include the information and communication industry and the professional, technical, and scientific services, represent a large share of the regional economy. The region is an attractive outsourcing location partly as a result of the high-speed internet access, competitive wages, and the amount of people educated in foreign languages.

A major problem for the sustainable economic development of the region is the marked monocentric model at both district and municipal level due to the large disparities between urban and rural areas. = Sofia – the capital city of Bulgaria is with 1,323,637 inhabitants, which remains the largest city and regional economy in Bulgaria. The capital has an important function as an administrative, transport, cultural, tourist, educational and industrial centre in Southeastern Europe and on the Balkans, which inevitably has consequences for the overall development of the metropolitan area. Sofia accounts for more than 40 % of Bulgaria's GDP and Sofia's GDP per capita is twice the country's average (National Statistics Institute, NSI). Over 6 industrial and logistics parks are located in or around Sofia, including the biggest economic zone in the region – Sofia-Bozhurishte.

The proportion of population with a university degree in Sofia is 51 %, which is the highest in Bulgaria and is a prerequisite for the region being the leading one in terms of social and economic development. 29 out of the 54 universities in Bulgaria are located in the Southwestern region (NSI). The total number of university students in Sofia is 110,596 or 48 % of all university students in the country. Sofia University was ranked the top university in the region for 23 professional fields, including Informatics and Computer Science, in the annual ranking of the best universities in Bulgaria in 2017. Moreover, the Technical University of Sofia (TU) was ranked the best university in 6 professional fields - Electrical Engineering, Electronics and Automation, Power Engineering, Communication and Computer Engineering, Mechanical Engineering, General Engineering, Transport, Shipping and Aviation. Part of the R&D division of the Technical University is the Laboratory "CAD/CAM/CAE in INDUSTRY", which provides SMEs and big companies with engineering and consulting services in respect of development and improvement of new products, prototyping and industrialisation for fast and effective realisation of new ideas and minimising the time to market.

Data from the Ministry of Education and Science shows that the number of recent graduates and current students in Sofia in the professional fields of Informatics and Computer Science, Communication and Technology, Mathematics and Mechanical and General Engineering is 14,300. In the past several years, an alternative form of IT education was developed in Sofia, offering shorter educational programs (6-18 months) than a traditional university degree. Over 10 private software academies offer courses in programming and web design, among others. The courses are often developed in collaboration with local IT companies in which are also using the opportunity to meet their labour demands.

There is one Science and Technology Park in Bulgaria and it is located in the Southwestern region - Sofia Tech Park (STP), a state-owned company with the main goal of strengthening the competitiveness of science and entrepreneurship in Bulgaria by improving the exchange of knowledge between academia and the

business community. The project was funded through the Operational Program “Innovation and Competitiveness”. The business model of the STP implies its sustainable development through funding, divided into three categories: 40 % by STP internal resources, 40 % by research projects and 20 % by industrial projects.

STP acts as a Digital Innovation Hub by providing access to 11 laboratories carrying out independent and collaborative R&D activities. One of its laboratories – 3D Creativity and New Products Rapid Prototyping Lab – provides services for rapid prototyping, involving its already available high-tech equipment. This laboratory uses both additive and subtractive technology systems that allow it to manufacture components of practically any shape and complexity. The lab provides the innovative rapid prototyping process called Hybrid Technology, which offers an alternative to the traditional methods of tool production and repairing. It features high design complexity and is a more affordable way of production and repair leading to a higher level of customisation and cost effective short run production.

STP also offers 6,200 square meters office space designed for start-up companies that develop innovative products within its three major areas: Information and Communication Technologies, Life Sciences, and Green Energy. The so-called Incubator offers the start-ups opportunities for networking, further development of company ideas and innovations, as well as access to various sources of funding and development support services such as legal, accounting, marketing and administrative services. In order to be admitted to the Incubator, the enterprises should undergo a rigorous selection process and meet the criteria developed in line with the requirements of the European Commission.

The Southwestern region seems to be the most attractive region for foreign investments in non-financial enterprises with 61 % EUR 7,280,166,988) of the country’s total foreign investments being located there (NSI). According to the Sofia Investment Agency, the capital has the lowest industrial prices in the EU and serves as regional ICT and R&D centre with over 40,000 people employed. Although global leaders such as SAP Labs, HP, Coca-Cola, VMWare, CISCO and many others already operate large R&D centres employing and educating thousands of highly qualified professionals, the proportion of foreign investments in R&D in the country is only 0.5 %. Moreover, the Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that the region ranks as a moderate performer in terms of R&D expenditure and as a low performer in terms of number of SMEs with product or process innovations and SMEs innovating in house.

The insufficient investment in R&D&I, combined with a shortage of ICT specialists, are among the reasons why the digitalisation process in Bulgaria and in the region is still slower than in other Member States. According to the Digital Economy and Society Index Report 2018, Bulgaria has retained its ranking (26th out of 28 EU countries) from last year with some slight improvements to its score. While Bulgarian companies are major users of radio-frequency identification (RFID), their use of social media or cloud computing services remains among the lowest in the EU, with respectively 9 % and 5.5 % of the total number of enterprises using them. Furthermore, only 7.1 % of Bulgarian SMEs sell online, which is well below the EU average of 17.2 %.

Demand-side barriers regarding the implementation of digital transformation

According to the latest Regional Development Plan of the Southwestern Region for 2014 - 2020, the capabilities of SMEs to resist through their end products the competitive pressure stemming from European producers are still limited. This entails

difficulties for the majority of SMEs to remain on the market (Bulgarian and/or foreign). The obsolete energy-intensive technologies and equipment remain a common issue. Innovation is rarely a competitive advantage of Bulgarian SMEs. For most enterprises, competitiveness is mainly associated with low labour costs and low cost of production. Access to information technology in the region is uneven with widespread access provided in the larger urban centres in the region. In smaller towns, villages and peripheral areas, the penetration rate of information technology is lower, as is the quality of services provided.

According to experts from the Ministry of Regional Development and Public, what is needed in order to increase the innovation potential of the economy in the region is technological renewal and productivity increase, increase in the number of employees in the high-tech sectors and in the export of high-tech products. The innovation capacity of the region will grow if there are more investments in the technological sectors and stimulation of the innovation activity and R&D.

The Bulgarian Innovation and Technology Hub – Bulgarian DigiTech 4.0 and the companies in its network, participating in the Smart Factories project, are well aligned with the first regional priority for increasing the competitiveness of the economy through the establishment of sustainable R&D infrastructure in the region. One of the major aims of the Digital Innovation Hub is to support the technological renewal and energy efficiency of SMEs. At the moment, the greatest obstacle for the achievement of this aim is the lack of a specific national strategy on the digital transformation of Bulgarian industry.

Structured macro-economic barriers

The regional unemployment rate of 3.3 % is the lowest in the country, and is significantly lower than the EU average of 7.6 % (Eurostat, 2018). The lowest unemployment rate, both for the region and country-wide, was reported in the city of Sofia (2.27 %) and the province of Pernik (6.05 %), while that in the remaining three provinces exceeded the national average: 8.75 % in Greater Sofia, 9.8 % in Kyustendil, and 10.5 % in Blagoevgrad. This means that while the unemployment rate in Sofia is definitely low, the unemployment rate in the rest of the region could and should be improved. Major problems in the rural regions are the insufficient infrastructure, underdeveloped telecommunication networks and limited access to the Internet. In this context, the employment rate for persons above 15 years of age is the highest for the country - 58.8 % (NSI, 2018), which is still far from the performance of the national goal for the implementation of the Europe 2020 Strategy (76 %).

According to demographic data from the NSI, 29.1 % of Bulgaria's population (2,108,394) lives in the Southwestern region of the country. Both the city of Sofia and the region of Sofia have a positive mechanical population growth – 4.8 ‰ and 0.1 ‰, respectively. Furthermore, even though the natural population growth in the region and in Bulgaria overall is negative, the lowest coefficient is found in the city of Sofia (-1.1 ‰). It is evident that even though the city of Sofia is growing, this happens at the expense of the rest of the country. Nevertheless, the data quoted shows that the Southwestern region has a definite demographic advantage in comparison to all other regions in the country.

Another macro-economic barrier is the low level of R&D spending and the unsatisfactory rate of introduction of high-tech productions, despite the relatively high scientific and engineering potential of the area, which should be directed towards

a more efficient realisation and connection with the real needs of the business. In terms of R&D spending, the region is mainly represented by the city of Sofia.

Sources of available public financing for innovation projects

According to the regional aid map for Bulgaria 2014-2020 (State aid SA.38667 (2014/N) - Bulgaria), the Southwestern region is admitted to regional aid with a maximum aid intensity of 25 % of the gross grant equivalent for a region (with an increase in maximum aid intensity of 10 % for medium-sized enterprises and 20 % for small enterprises). The companies in the region benefit directly from the financing opportunities at the national level - operational programs co-financed by the national budget of Bulgaria and the European Union. For SMEs outside of Sofia region and Sofia city, the so-called local action groups are created in order to allow fair competition within the boundaries of a specific operational program.

Start-up or existing micro, small and medium-sized enterprises in the sectors identified in the National SME Promotion Strategy 2014-2020 can benefit from the Innovation and Competitiveness 2014-2020 national opportunity program. There are four priority axes, promoting simultaneously innovation and competitiveness:

- "Technology Development and Innovation"
- "Entrepreneurship and Growth Capacity for SMEs"
- "Energy and Resource Efficiency"
- "Technical Support"

The fourth priority axis is connected to the removal of barriers in respect of secure gas supply.

In 2015 the budget of the operational program "Innovation and Competitiveness" was reduced from 1,390,135,903 EUR to 1,270,135,903 EUR, of which 1,079,615,516 EUR is EU funding. The overall utilisation of the program's funds as of 31 December 2016 amounts to 10.2 % of its budget. In the same year, Sofia and the Southwestern region were leaders in the number of contracts concluded under the first priority axis and third on the second priority axis. Companies in the region received between 35 % and 45 % of the grant, depending on the size of the enterprise.

Starting this year, the Fund Manager of Financial Instruments in Bulgaria has developed the first equity instrument in the country to finance both newly created companies with innovative business ideas and existing ones that need capital to make their first steps on the market. The initiative is funded by the operational program "Innovation and Competitiveness" 2014-2020. The resource from the Operational Program amounts to 51.2M EUR and is divided into three separate funds:

- Initial Stage I Accelerating and Financing Fund: 13.9M EUR
- Initial Stage II Accelerating and Financing Fund: 18.2M EUR
- Initial Stage Financing Fund: 19.0M EUR

SMEs in the region and the country can benefit from centralised EU programs "Horizon 2020", which offer special financial instruments for innovation (Instrument for the Promotion of Small and Medium Enterprises), participation in research (Fast Track to Innovation in Horizon 2020), attracting experienced researchers in the field of innovation (INNOSUP). As of 4 January 2018, the results of the Bulgarian participation in the Horizon 2020 framework program are 347 projects and 56M EUR

attracted according to information published on the website of the program for research and innovation. This ranks our country in the 24th place out of 28 countries.

Sources of private sector financing for innovation projects

The investment activity in the Southwestern region is focused mainly in the Sofia administrative region. The financial private sector aiming to support the start-up ecosystem is quite developed compared to the rest of the country. The start-up ecosystem features capital funds and business angels, which are supplemented by Sofia Tech Park. There are a number of venture capital funds and angels operating in the region, some of which are CEO Angels Club, LaunchHub Ventures and Bulgarian Angels. Furthermore, the BrightCap Ventures under the JEREMIE Holding Fund Bulgaria for equity investments in SMEs, which has a capital of 25M EUR, will support Bulgarian SMEs with equity investments over the next five years. Although the fund does not operate exclusively in the region, Southwestern region innovative SMEs could take advantage of the 5M EUR in the form of private financing that it offers.

Even though it is not targeting companies only in the Southwestern region, the venture capital fund Eleven is among the few funds in Bulgaria which are focusing on innovative start-ups. It has financed more than 100 companies in the last three years and the financing total amount is about 12M EUR. Eleven 2.0 has recently announced that it will invest a further 6M EUR in technology start-ups in Bulgaria and Southeast Europe. The capital of the new private equity fund is entirely private and comes from successful entrepreneurs from Bulgaria and the region. Their aim is to build a supportive infrastructure of knowledge, capital, global partnerships and a cohesive community. The creation of other venture capital funds similar to Eleven would certainly accelerate the development as well as digitisation in the region.

Positive and negative examples of initiatives undertaken in the region

The Southwestern region of Bulgaria is currently the country's leader in terms of stimulating and financing start-up initiatives. The regional centre and the capital of Bulgaria – the city of Sofia, has seen the highest rise in the amounts successfully undertaken start-up initiatives in the country, a result that is highly attributable to the substantial amounts of financial support provided by capital funds such as the LAUNCHHub and Eleven.

One such successful start-up initiative is "Mellissa climate" which produces a series of devices that allow their users to manage and control their air conditioners remotely through a smartphone application. Currently, the company produces devices that are compatible with over a thousand different models of air conditioners, which not only allow for remote controlling of the temperature and the working schedule of the AC units, but also decrease the energy output of the cooling system by 10 % without impairing its efficiency. The company's seed financing was provided by Eleven investment fund which granted the start-up 200 thousand euros at inception. The company plans to invest the remainder of this money to expand its operation outside of Sofia – in the city of Veliko Tarnovo as well as to expand its product range by creating similar in function devices for gas and heating installations. According to the founders of "Mellissa climate" – Lyubomir Yanchev and Blagovest Dimitrov – the key to establishing a successful start-up with high growth potential is to constantly reinvest the business' earnings into expansion and innovation, something which according to them earned "Melissa Climate" the 2016 award for most successful start-up.

Although a decent number of start-up companies in the Southwestern region, such as “Melissa Climate”, have expanded tremendously during the start-up wave of 2016 and 2017, an even larger number of undertaken initiatives have failed to penetrate the market and produce positive financial results. According to Stefan Ganchev, an investment partner in the LAUNCHub fund, the main reason for the failing start-ups is not due to the lack of ideas or initiative on behalf of the founders, but the lack of understanding and experience in the administrative aspect of business management and the still insufficiently developed start-up “ecosystem” that fails to address many of the needs of starting companies. He notes, however, that many of the new generation entrepreneurs are forward thinking people who are motivated to help and support each other’s businesses grow successful. He is positive that if that cohesion trend among start-up entrepreneurs continues, the amount of successful start-ups will rise exponentially in the next five to ten years.

2.2.1.2 Northeastern Region

The Northeastern region of Bulgaria covers the northern part of the Bulgarian Black Sea coast, a portion of the Eastern Balkan Mountains, and part of the regions Ludogorie and Dobrudja. It is comprised of the administrative districts of Varna, Dobrich, Shumen, Turgovishte, Razgrad and Silistra as well as 35 municipalities, and has a population of 944,458 people (Eurostat, 2017). Its regional capital is Varna, which is known as the sea capital of Bulgaria and is its third largest city. The city takes over half of the region’s population and is known for being a tourist and logistical centre. The economic scene in the region is quite diversified, but it is dominated by low-tech industries. Leading for the regional economy are tourism, maritime industry, transport, manufacturing and electrical appliances.

The Northeastern region contributes 11 % to the national GDP (4.9bn EUR), which makes it the fourth largest region in the country. According to the National Statistics Institute (NSI), in 2017 the services sector accounted for 63.5 % of the regional gross value added, industry for 28.7 % and agriculture for 7.7 %. Moreover, the small and medium enterprises (SMEs) in the Northeastern region represent 13.4 % of the total number of SMEs in Bulgaria. Their share in the regional economy is particularly high – 99.0 %, or 53,092 SMEs in total in the region (NSI, 2018).

Against the backdrop of the region’s general tendency to lag behind, the city of Varna shows positive development in economic, social and cultural terms. It almost exclusively defines the positive characteristics of the region and possesses the qualities of a centre of national and arguably, supranational, significance. The city has been ranked as the best place for starting a business in Bulgaria, some 20 places above the capital, Sofia, according to the World Bank Group’s report “Doing Business in the European Union 2017: Bulgaria, Hungary and Romania”. Indeed, the city scores above the EU average, with leading advantages being the low initial start-up expenses, a faster VAT registration procedure and a simpler process which does not require registration at the municipality. This is an advantage that could be exploited, if proper effort and funding are directed to the city.

Another advantage of Varna is the engineering potential. There are six universities in the city, which have laboratories and research facilities. Those are the Technical University of Varna, the Varna Free University, the Medical University Varna, the University of Economics, the Varna Naval Academy and the Varna University of Management. Of particular interest is the Technical University, which was established to ensure the training of engineering staff in the fields of shipbuilding, transportation,

mechanical engineering and electrical engineering, necessary for the development of industrial complexes operating in the Northeastern region.

In terms of the state of digitisation in Bulgaria, the country has been ranked 26th out of 29 countries in the EU by the "Digital Economy and Society Index Report 2018" in terms of its integration of digital technology, which covers both business digitalisation and e-commerce. This is an indication of the general lack of digital focus, which remains one of the greatest challenges for businesses in Bulgaria. The Northeastern region, in particular, has been classified as a Modest Innovator (the lowest level of maturity of country/regional innovation system) in the "Regional Innovation Scoreboard 2017" conducted by the European Commission. However, the Report also indicates that the factor "Design applications" is one of the regional relative strengths compared to Bulgaria. In this context, the start-up scene in Varna has been evolving and now comprises various initiatives such as:

- Beehive, the main hub and local working space, which provides information about start-ups and educates the local community on digitalisation, and also hosts various lectures, events and workshops.
- VarnaLab, a space to share knowledge, ideas and technologies, and help the community with trainings, co-working space, hacking and others.
- Techstars Start-up Weekend Varna, the biggest event dedicated to start-ups with over 100 participating companies. It is a 54 hour event that brings together Varna designers, developers, entrepreneurs, and experts from all domains. All Techstars Startup Weekend events follow the same basic model: start-ups are welcome to pitch their startup ideas and receive feedback from their peers. As determined by popular vote, teams unite around the top ideas and embark on a three-day journey for business model creation, coding, designing, and market validation. The weekend culminates with presentations in front of local entrepreneurial leaders with another opportunity for critical feedback.
- CloudConfVarna, an IT conference for cloud infrastructures.
- Europe Code Week, which consists of lectures about programming covering issues such as Android and IOS development, project management, SEO, and others.

The Innwave Summit 2018 in Varna is a testament to the increasing importance of the city in terms of digitalisation and funding opportunities for start-ups. It is one of the biggest high-tech conferences in Southeast Europe and its major focus is the digitalisation of the business and the public sector by exploring innovations in marketing, sales, e-commerce and other industries. The goal of the event is to encourage innovative and creative thinking and to create a favourable environment in which participants can exchange successful business models, experience and good practices. The Summit is being held in partnership with the municipality of Varna and with the support of the Ministry of Economy of Bulgaria, the European Start-up Network and Start-up Europe. The conference brings together world brands and venture capital funds from a number of countries, whose primary purpose is to help forum visitors to make a digital transformation of their business and sell globally. It is a step towards tackling the issue of lack of sufficient funding in the region, which has slowed down the dynamic and continuous development of the start-up culture in the city.

Varna's Regional Agency for Entrepreneurship and Innovations (RAPIV) is a non-governmental organisation, which carries out activities aimed at stimulating the

regional economies through the development of entrepreneurship and innovations. In order to provide support to local businesses, it has established the following structures:

- the High-Tech Park Varna and Business Incubator, which provide start-up entrepreneurs with business, legal and financial consulting services in respect of technological and technical problems, marketing issues, intellectual property rights and other similar issues; and
- the Innovations and Technology Transfer Centre, which supports regional economic development through the implementation of different national and EU projects.

Even though RAPIV is not a relatively new institution as it was founded back in 2007, more efforts and funds need to be committed to it in order for tangible results to be observed in terms of stimulating the regional economy.

Demand-side barriers regarding the implementation of digital transformation

The low level of digitalisation among enterprises is one of the major structural problems in Bulgaria. As mentioned above, Bulgaria ranks near the bottom of the Digital Economy and Society Index in the EU. In particular, the Northeastern administrative region ranks third out of the six administrative regions of Bulgaria in terms of overall household connectivity to the internet.

A current progress in the level of digitalisation is mainly attributable to the large cities in the area as well as the regional centre – the city of Varna. Varna marked the highest growth in terms of digitalisation in the Northeastern region. According to expert analyses (Galina Momcheva, Chair of ICT Cluster – Varna) and research conducted among SMEs in the Varna region (input for Bulgaria's Research and Innovation Strategies for Smart Specialisation, August 2013), the main digitalisation barriers in the region are the lack of digitalisation initiative among SMEs, as well as the shortage of sufficiently qualified professionals in the sphere of digitalisation. Companies are not oriented towards digitalisation as a result of the low competition-driven market in the sphere and classify it as risky investment, as well as the shortage of sufficiently qualified professionals in the sphere of digitalisation. Steps have been taken in order to improve the level digitalisation by increasing the funding of professional education in IT and by increasing the institutional support by financing digitalisation efforts via various projects and programs, such as the Operational Program "Innovation and Competitiveness". Recent efforts in this respect also include Varna hosting the 5th Annual Conference of the Outsourcing Industry, in which the main topic was the impact of digitalisation on business and how it could be encouraged.

The SMEs located in the urban areas of the Northeastern region are increasingly becoming more aware of the benefits of digitalisation. However, the same cannot be said about the SMEs located in the rural areas of the region, which are definitely lagging behind. Some of the factors that contribute to this developmental disparity are the lack of access to quality education in the areas of business and IT in the rural areas, the underdeveloped infrastructure as well as the generally unattractive salaries and working conditions local enterprises offer in comparison to the ones in larger cities. This has led to clustering of professionals and companies in the urban areas and a widening of the economic and digitalisation gap between the rural and urban areas in the region. Certain strategies such as encouraging urban businesses to expand their operations into rural areas as well as implementing programs and

projects aimed at improving the digital infrastructure and training of the human capital would certainly benefit the region as a whole, serve to reduce the developmental gap and harmonise the digitalisation process throughout the Northeastern region.

Structured macro-economic barriers

According to the European Job Mobility Portal in the first six months of 2017, the average registered unemployment rate in the North-East region was 8.2 %, compared to the national average of 7.7 %..The unemployment rate in the province of Varna (5.1 %) was lower than the national average, while the unemployment rate in the remaining provinces stood at 8.0 % (Dobrich), 13.2 % (Shumen), and 14.5 % (Targovishte).

As mentioned above, there are vast intra-regional disparities and inequalities in the Northeastern region, especially between the city of Varna and the periphery represented by remote rural districts. The inequalities between the regional centres and the constituent municipalities within the districts have been intensifying as well. Some of the key challenges in the rural regions are the insufficient infrastructure, underdeveloped telecommunication networks, and limited access to the Internet, inadequate sewage network in small settlements, and inefficient waste collection and treatment of household waste. It should be noted that the economic situation in the North-East planning region is dominated by the seasonal nature of labour supply and demand, determined by the structure of the local economy.

Moreover, demographic data from the 2011 census demonstrates a decrease of the region's population by 53,200 inhabitants compared the previous census in 2001. The population of all districts, with the exception of Varna, has decreased. The natural population growth in the region is negative, but to a lesser extent than in other regions of the country. External migration is quite high, especially as more and more young people are leaving the area and relocating to Sofia or abroad. Furthermore, the potential of the labour market for attracting highly qualified staff is limited.

Another macro-economic barrier in the region is the low level of R&D spending – 7 % from the country total R&D spending (NSI, 2016) leading to unsatisfactory rate of introduction of high-tech productions, despite the relatively high scientific and engineering potential of the area, which should be directed towards a more efficient realisation and connection with the real needs of the business. In terms of R&D spending, the region is mainly represented by Varna and to a lesser extent, by Shumen.

Sources of available public financing for innovation projects

More than 900 EU financed projects with a total funding amount of more than a half billion euro have been executed in the Northeastern region for the past three years. Around 50 of them were dedicated to stimulating innovation and business development.

As the demand for business innovation in the region has increased in the past few years, the regional administration of Varna in conjunction with the EU Social Fund has started two major initiatives – “Support for Developing Innovation among Start-ups” and “Support for Integrating Innovation among the Regional Enterprises”. The regional administration has allocated over 50M EUR for the former one. All regional companies, which have existed for more than three financial years, can apply to receive funds through this initiative. On the other hand, the latter initiative aims to

provide funding for companies that have operated for less than three financial years with a maximum amount of the individual grant being EUR 204,516.

Details of a few additional programs that aim to stimulate innovation in the region are listed below:

- The “Youth Entrepreneurship Program for Employed, Unemployed and Inactive Youth under the Age of 29 in the Northeastern Region” project aims to provide income for unemployed, inactive or employed persons under the age of 29 who wish to start their own business, thus increasing the employment rate in the region. It is co-financed by the EU Human Social Fund and the National Fund for Development of the Human Resources, and its duration is two years.
- The goal of the “Women Entrepreneurship Encouragement Program in the Northeastern Region” is to supply women with the necessary business and entrepreneurship skills for establishing a successful business. The program is co-financed by the EU Human Social Fund and the Ministry of Economy of Bulgaria, and is carried out in a joint effort with ten other EU member states. The total financing amounts to EUR 2,021,050 and its duration is three years (from 1 June 2018 until 31 May 2021).
- The INTRA project "Internationalisation of Regional SMEs" is financed by the INTERREG EUROPE program, prioritising the competitiveness of regional SMEs. It focuses on the role of public authorities in creating services to promote the internationalisation of the companies and support the competitiveness of regional economies, thus contributing to the objectives set out in the Europe 2020 Strategy. The project was initiated on 1 April 2016 and its planned conclusion is on 31 March 2021. Its planned budget is EUR 1,640,056.

Moreover, SMEs in the Northeastern region could also take advantage of the various EU initiatives and operational programs targeting SMEs in Bulgaria as a whole, such as “Initiative for the Small and Medium Enterprises 2014-2020”, “Rural Development Program 2014-2020”, “Maritime and Fisheries Program 2014-2020”, “Competitiveness of Enterprises and Small and Medium-sized Enterprises”, “Horizon 2020”, “Erasmus for Young Entrepreneurs” and others. In addition to the ongoing European programs, the local administration frequently allocates funds for innovative development and business modernisation for various industries and enterprises.

Sources of private sector financing for innovation projects

The Northeastern region investment activity is focused mainly in the Varna administrative region. The financial private sector aiming to support the start-up ecosystem in Varna is still developing. The Varna start-up ecosystem features capital funds and business angels, which are supplemented by the Varna Business Incubator. For example, the BrightCap Ventures under the JEREMIE Holding Fund Bulgaria for equity investments in SMEs, which has a capital of 25M EUR, will support Bulgarian SMEs with equity investments over the next five years. Although the fund does not operate exclusively in the region, Northeastern region innovative SMEs could take advantage of the 5M EUR in the form of private financing that it offers. In addition, foreign direct investments (FDI) in the Northeastern region amount to 2.27M EUR (NSI, 2017).

Even though they are not specifically targeting the Northeastern region, the venture capital fund Eleven should be mentioned here as it is among the few funds in Bulgaria which are focusing on innovative start-ups. It has financed more than 100 companies in the last three years and the financing total amount is about 12M EUR. Among the

more popular investments are Melissa (smart home products), EnhanCV (a professional CV service), Dronamics (a company that develops an unusual unmanned civilian airliner), TaxiMe (the high-end taxi driver application rating), and Farmhopping (a company that delivers products from small and medium farms directly to end customers). Eleven 2.0 has recently announced that it will invest a further 6M EUR in technology start-ups in Bulgaria and Southeast Europe. The capital of the new private equity fund is entirely private and comes from successful entrepreneurs from Bulgaria and the region. Their aim is to build a supportive infrastructure of knowledge, capital, global partnerships and a cohesive community. The creation of other venture capital funds similar to Eleven would certainly accelerate the development as well as digitalisation in the region.

Nevertheless, the majority of new enterprises in Bulgaria are financed through debt as there is not enough awareness about the opportunities of equity financing as well as its advantages, which include mentoring in terms of management and knowhow as well as access to a business network. Therefore, more effort should be directed towards educating the technology start-ups in particular about the different sources of financing. A further complication is the fact that the Bulgarian market is relatively small and that the newly established enterprises more often than not target only the Bulgarian market and lack international aspirations. Hence, big capital funds have not been very interested in the Bulgarian market so far.

Positive and negative examples of initiatives undertaken in the northeastern region

The Northeastern region has seen a significant rise in the number of business initiatives undertaken for technological development as a result of the administration of the region starting to emphasize more the positive effects of digitalisation on businesses and stimulating start-up companies by assisting them in preparing their business plans.

One such start-up initiative, which has now turned into an internationally operating business entity, is Composity, a company offering business management software with integrated marketing, financial, management and retail tools, needed for carrying out the daily operations of SMEs across several industries. The company currently caters to clients representing more than 5,000 SMEs based in 60 different countries. The venture received its seed financing in 2006 from the Varna municipality and was subsequently awarded European financing in 2012. The funds were used for rebranding and expansion. According to the company's founders, the main reasons behind Composity's success is the constant expansion of the product line and the improvement of its existing products, as well as the implementation of a strategy of targeting the right markets and businesses.

Another successful business initiative that has been operating for the past three years is VEVs, a business website builder that allows its customer base to freely and easily create and manage their websites. The start-up was initially financed by the privately owned StivaSoft, a company operating in the same line of business with a high market share in the Northeastern and the Southwestern regions. According to Veselin Stoilov, the CEO of VEVs, the success of the company should be attributed to the fact that it not only provides SMEs with easily accessible and intuitive tools for creating web pages, but also with supplementary services, which include consulting services and trainings on how to properly create websites that market the product to the desired customer base. Mr. Stoilov says that at the core of successful start-ups is not creating something that has never been seen before, but enhancing already existing products and services, and thus, increasing their value.

2.2.2 Croatia

2.2.2.1 Adriatic Croatia

Adriatic Croatia is located on the shore of the Adriatic Sea. It consists of seven counties. It should be noted that Croatia has a county administrative division, therefore the NUTS II level of aggregation does not present an administrative unit in Croatia and thus overarching regional policies (covering all seven counties) do not exist at this level. The biggest cities in Adriatic Croatia include Split and Rijeka. The region has six notable harbours Rijeka, Zadar, Šibenik, Split, Ploče and Dubrovnik. The region is a popular tourist destination. According to the Bisnode, there were 43,750 SMEs in Adriatic Croatia in 2017.

In 2016, the region has generated a GDP of 14.759 M EUR (around 32 % of national GDP). According to EU Regional Competitiveness Index 2016 (RCI 2016) - a report that ranks regions based on scores across three dimensions (basic, efficiency and innovation) - Adriatic Croatia is ranked 232nd out of 263 regions based on GDP per head (PPS). Considering, overall competitiveness ranking, the region was 222nd out of 263. Within innovation dimension - which scores Technological Readiness, Business Sophistication and Innovation - the region was 196th out of 263.

The region has five public universities (out of eight in the country). The universities are located in Pula, Rijeka, Zadar, Split and Dubrovnik. Additionally, the region has four public polytechnics and seven private colleges.

There are several technology parks, technology development & transfer centres, technology transfer offices and related institutions in the region, such as:

The Science and TP of the University of Rijeka – Step Ri – provides offices to companies in preincubation and incubation stages. Additionally, it provides business consulting services and consulting on innovation management. A part of consulting services is free for Step's tenants and SMEs. Currently 28 enterprises are Step's tenants. Step is also a member of Enterprise Europe Network.

The Research Centre for Materials in the Region of Istria – METRIS - METRIS was established within the project "Research Centre for Metal Industry in Istrian County – MET.R.IS.", co-financed by the EU from the Phare 2006 fund. The main goal of the project was the creation of an infrastructural basis for innovative research and development in the metals industry in the Istrian County with the purpose to improve the level of the research and development projects put into operation and to influence the competitiveness of the Istrian and Croatian metals industry on the global market. The specific goal of the project was to provide research and development services for the small and medium sized metals industry operators (SMEs) in the Istrian County.

Technology Transfer Office University of Split – TTO was founded within TEMPUS project - "Stimulating Croatia's Entrepreneurial Activities and Technology Transfer in Education-CREATE". TTO support scientists in all phases of technology implementation: from idea and process of intellectual property protection, through setting up businesses and commercialising intellectual property. Services TTO provides to entrepreneurs through the EEN Network are free of charge and include information on technology supply and demand, publishing technological profile in the network technology database, organisation of brokerage events and trainings about innovation management, support in finding partners for European research and development programs.

Technology Transfer Office University of Rijeka – the TTO was founded within the Croatian Technological Development Project financed from the World Bank loan, with the contractual participation of the Ministry of Science, Education and Sports. TTO represents the link between the academic and business community, encourages research and professional work, and promotes the protection and commercialisation of the results of this work, for the benefit of researchers, constituents and the University as a whole.

Despite a number of universities and aforementioned institutions related to innovation, Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that SMEs from Adriatic Croatia, fall behind EU-average and country's average on almost all observed indicators. The underperformance is especially evident on the following indicators: EPO patent applications, R&D expenditures business sector, Sales new-to-market/firm innovations and Lifelong learning.

Demand-side barriers regarding the implementation of digital transformation

According to the EC's Digital Economy and Society Index 2018 (DESI), Croatia belongs to the low performing cluster of countries, ranking 22nd out of the 28 EU Member States. Over the last year, Croatia made slow progress on the DESI indicator "Integration of Digital Technology by businesses", and fell back from rank 17 to rank 21 because other countries were progressing faster.

Croatia's greatest challenge in digital remains its low performance in connectivity (DESI 2018, rank 27). Rural broadband connectivity and fast broadband coverage are limited, while prices for fixed broadband remain the highest in Europe. The incumbent (together with its subsidiaries) has a very high market share. Croatia could focus more on its low connectivity to achieve the Digital Agenda for Europe goals and in particular to reach fast broadband coverage of the entire population by broadband speeds of at least 30 Mbps. It would be beneficial to speed up the rollout of the approved EU-funded access and backhaul networks. In particular, the latter seems to be blocked at government level, with Croatia risking losing EU funds. In this context, alternative operators would benefit the most from backhaul deployment. In general, Croatia could be more vigilant in ensuring competition in the market. This would benefit consumers and stimulate investments in fast internet infrastructure and take-up of related retail products. If no action is taken, Croatia risks falling even further behind in the creation of a digital economy and society.

Croatia does not have a specific strategy for digitalisation of the economy. Two strategies partially cover this field: eCroatia that is oriented towards digitalisation of public institutions and S3 strategy that recognises IT as a horizontal pillar but with no specific measures for developing IT sector. In spite of the relative absence of national digitalisation policies, Croatian companies are identified as medium performers (DESI 2018). Therefore it would, be even more beneficial for the Croatian economy if Croatia's companies could benefit from a targeted digitalisation strategy. In addition to absence of the national industry digitalisation strategies¹¹, some of the main challenges according to conducted interviews with Croatian Digital Innovation Hub, which take part in the Smart Factories in the new EU Member States project, are:

¹¹ Following the September 2016 elections, the new Government was setting up a Central Office for the Development of the Digital Society. Digital Strategies are currently being updated and are to be released before the end of the year.

- **Skillsets:** With the wave of the automation and industrialisation, there is a need for the reskilling in order to keep track. Unfortunately, that process still has not begun in Croatia and specific skillsets required, such as robotic programming and Big Data Analytics are still required.
- **Capacities:** more than 99 % of the Croatian economy are small and medium enterprises mostly micro and the lack of their absorption capacities are recognised especially related to their knowledge, digital and management skills and competences.
- **Lack of awareness:** usually stems from insufficient knowledge and skills related to digital transformation and the opportunities it offers.
- **Lack of a common platform:** place where all the stakeholders relevant to the regional industrial ecosystem could meet and exchange ideas, collaborate, compete, and grow together. None of the currently present institutions (incubators, entrepreneurial support facilities, technology parks, cluster organisations, universities and RTO's, private companies, local/national governments) is able to offer a 'holistic approach' to digitisation as an industry-wide transformation process. Each of these actors offers only a partial solution to the general problem of digital transformation.
- **Scalability:** several enterprises are at the early stages of Industry 4.0 design and implementation. They have carried out some pilots on assembly lines, but the challenge is to scale up across enterprises and multiple factories.
- **Funding:** Funding is important but assumes more than just money. A lot of business management buy-in is required to sign up to Industry 4.0 roadmaps.

Structural macro-economic barriers

According to Eurostat data, Adriatic Croatia had an unemployment rate of 10.9 % in 2017, which slightly below the country's average. Despite a relatively high unemployment rate, many employers struggle to find qualified employees suiting their needs, especially in tourism related services during summer months. This is primarily the result of negative emigration trends of qualified (and young) persons to other EU countries. The impact of worker shortage has led to a slight increase in wages and an increase of quotas for labour force import. Another problem is a high share of unemployed youth with upper secondary education and an increasing share of unemployed university graduates, suggesting a skills mismatch. Low job creation levels and a rigid labour market, amongst other things, have been blamed for the relatively more adverse effects of the crisis exerted on the young, whilst skills mismatch is another factor.

One of structural problems faced by the Republic of Croatia is the low volume of business investment in research and development, despite the abundance of existing tax reliefs. High value added services and knowledge-based services remain a negligible part of the export, while the skills and technological possibilities stagnate. This trend is reflected in Croatian export, technological success and ranking on the competitiveness scale compared with other countries in the EU.

Sources of available public finance for innovation projects

There are numerous co-financing opportunities supporting innovative projects, mostly coming from EU funds. However, there are no region specific sources of public financing that target innovative projects.

Operational Programme Competitiveness and Cohesion (OPCC) 2014-2020

– Allocation from European Regional Development Fund (ERDF) is around 4.3bn EUR , combined with 2.5bn EUR of Cohesion fund (CF), total OP budget is 8bn EUR. Under OPCC, about 57 % of ERDF resources are allocated to supporting Research and development (R&D), technological development and innovation, the digital agenda, the competitiveness of Small and medium-sized enterprises (SMEs), and the shift to low-carbon economy. Additionally, entities from Adriatic Croatia can benefit from programs at EU level, such as Horizon 2020.

Croatian Bank for Reconstruction and Development (HBOR) – HBOR has several credit lines e.g. Inventions dedicated for innovative SMEs, which provide lower interest rates under certain conditions.

Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO) – HAMAG-BICRO manages five programs to support public and private users in each phase of the innovation process:

- Proof of Concept (POC) – The PoC programme supports innovation at the earliest stage of research to provide pre-commercial capital for technical and commercial verification of the innovative concept
- Development of knowledge-based enterprises (RAZUM) – RAZUM Programme provides start-up financing for newly established enterprises and initial financing for the development of new products or services to existing SMEs
- Programme for Development of Technological Infrastructure (TEHCRO) – the objective of the TEHCRO Programme is to increase the competitiveness of the Croatian economy through the development of effective business support institutions
- Research and Development Programme (IRCRO) – IRCRO supports SMEs to cooperate with the scientific research institutes in launching their own R&D activities
- Support to Technology Transfer Offices (TTO Programme) – The aim of the Program is to strengthen the role of the Technology Transfer Offices (TTO) at universities and public research institutes in Croatia as the focal point for encouraging and implementing technology transfer activities.

Additionally, there are two acts in place, which support innovation projects – The State Aid for Research and Development Projects Act (Official Gazette 64/18) and Act on Investment Promotion (Official Gazette 102/15, 25/18). The acts provide tax incentives to enterprises with innovative projects under certain conditions.

Currently, The European Investment Fund (EIF) and the Ministry of Regional Development and EU Funds of Croatia (MRDEUF) have presented a signed agreement to establish the Croatian Financial Instrument 'ESIF Venture Capital Fund'. The ESIF Venture Capital Fund instrument has an Acceleration compartment that will turn investments into risk capital funds targeting local small and medium-sized enterprises with high growth potential.

Sources of private sector finance for innovation projects

Croatia does not have a local venture capital fund. So far, Croatian start-ups had to attract funding from international investors, with investors ranging from Y Combinator to 500 Start-ups. There are several private equity funds operating in Croatia but they usually invest in enterprises in later stages of development, and not innovation projects.

Positive and negative examples of initiatives undertaken in the region

The Bura supercomputer at the University of Rijeka is the most powerful supercomputer in the Adriatic region. Named after the Croatian north wind, it is used in biotechnological and biomedical research and is also available to institutions and companies from abroad. Bura was installed by Bull Atos and is a 'green' computer according to testing performed by Green 500, placing it at 175th position worldwide with 234 teraflops. As one of the leading players in high-performance electric cars, Croatia-based Rimac signed an agreement with the University of Rijeka at the beginning of December 2017 on using the super computer for finishing the development of the latest Concept Two electric car, which has 1 384 HP and a top speed of around 400 km/h.

Dubrovnik Smart City, in March 2016 Dubrovnik's first Smart Street at Obala Stjepana Radića opened, a pilot project developed in strategic partnership between the City of Dubrovnik and Hrvatski Telekom, IT company Cisco, and in collaboration with local partners. The Smart Street features public lighting with a multifunctional sensory network, and a variety of access technologies, from optical links to 4G and Wi-Fi networks. These technologies allow the residents and visitors of Dubrovnik to obtain free of charge Internet access within the pilot project's footprint, at high speed and throughput (50 Mbit/s). The Smart Street project also includes a traffic management solution that will use cameras to identify traffic violations, as well as innovative parking technology. The parking management system will automatically recognise vehicles and perform contactless charging of parking fees. It will also, both via a smartphone application and via digital panels, provide real-time information on the vacancy status of parking spots, not only in Dubrovnik's Smart Street, but also all over the city. An important part of connected solutions in the Smart Street is the monitoring and control of environmental parameters that will provide extremely useful data for the city's environment. All solutions are connected with the city's legacy systems, and the Cisco Digital Platform will keep all collected data open for development of new solutions.

Technological and Business Innovation Centre for Mariculture (MARIBIC) owned by the University of Dubrovnik, was established in June 2008 by the Mariculture Development Research Centre as part of the technological development program - TEHCRO managed by HAMAG- BICRO. MARIBIC is partially financed by the World Bank loan. Its main task is to become an expert, educational and technological support to the aquaculture industry in developing new technologies and promoting entrepreneurship. Within the framework of technological innovation, MARIBIC is working on developing new, evaluating and transferring existing technologies, developing and evaluating new equipment, and introducing new types and products into aquaculture. In the field of research, MARIBIC works on research projects with domestic and foreign scientific institutions, with producers and their organisations, and with local self-management. MARIBIC's business-incubation activities include helping new companies in all initial phases of the organisation: preparing a business plan, contacts with financial institutions, planning the production, and eventually transferring technology and providing a well-equipped business space. Organising seminars and presentations of experts in different fields of aquaculture. Additionally, MARIBIC conducts continuous training and information to manufacturers on new technologies, trends, equipment, marketing and local aquaculture industry issues. Although the initiative was, well-intentioned MARIBIC has struggled with its underlying business model and is now subject to insolvency proceedings under domestic law.

2.2.2.2 Continental Croatia

Continental Croatia is one of the two NUTS II Regions of Croatia. The region forms the continental part of the country and includes Northern, Central and East Croatia. It consists of 14 counties. It should be noted that Croatia has a county administrative division, therefore the NUTS II level of aggregation does not present an administrative unit in Croatia and thus overarching regional policies (covering all 14 counties) do not exist at this level. The biggest cities in Continental Croatia include Zagreb, Osijek, Slavonski Brod, Karlovac, Sisak and Varaždin.

Data for 2017 show that there are around 2.1 active companies per km² in Croatia and 2.6 companies per km² in Continental Croatia. However, there are major discrepancies relative to counties where City of Zagreb has 64 companies per km² and Požega-Slavonia County counts 0.43 companies per km². According to the Bisnode, there were 73,926 SMEs in Continental Croatia in 2017 with 6,459 new established SMEs in 2017. There are 40,120 companies registered in Zagreb and holds 71.7 % of total realised net revenues in 2017, while City of Velika Gorica with 1,508 registered companies holds the second place in Continental Croatia.

In 2016, the region has generated a GDP of 31.623M EUR (around 68 % of national GDP). According to EU Regional Competitiveness Index 2016 (RCI 2016) – Continental Croatia is ranked 224th out of 263 regions based on GDP per head (PPS). Considering, overall competitiveness ranking, the region was 220th out of 263. Within innovation dimension – which scores Technological Readiness, Business Sophistication and Innovation – the region was 193rd out of 263.

The region has three public universities (out of eight in the country). The universities are located in Koprivnica, Osijek and Zagreb. Additionally, the region has seven public polytechnics and seven private colleges. The number of ICT specialists increased from 2.7 % to 3.3 % and the share of graduates in Science, Technology, Engineering and Mathematics (STEM) in the 20-29 years old cohort went up as well, reaching 1.7 %.

Continental Croatia has many business support institutions that promote entrepreneurship, innovation and technology development in the region. Moreover, 54 representatives of the scientific-research sector, private sector and business clusters, professional organisations and associations, as well as local and regional self-government form the Croatian ICT cluster with headquarter in the City of Zagreb with aim to promote ICT sector competitiveness and overall Croatian economy.

The most active technology parks, technology development and transfer centres, technology transfer offices and related institutions in the region are:

Zagreb Innovation Centre Ltd. – ZICER – offers its services to entrepreneurs through Technology Park Zagreb, Plavi ured, Startup Factory Initiative and Zagreb forum. Entrepreneurs can get the entire infrastructure and consulting, education and support needed to facilitate and expedite the journey from idea to market.

Technology Park Varaždin – offers free services to its tenants and deals with the establishment of incubation centre for innovative start-up companies, establishment of a mechanism for improvement of existing technologically innovative companies, improvement of transfer of knowledge from universities and development centres into the economy, etc.

Poduzetnički inkubator ZIP - founded in 2012 with the goal of helping aspiring entrepreneurs from the region of Southeastern Europe to build their companies, ZIP has established itself as the strongest start-up incubator in the region.

Business incubator BIOS, Osijek – supports small and medium sized enterprises development by providing them with office space and production facilities and other business-related services in the most critical development phases. BIOS has full capacity with companies of different profiles and activities and currently supports seven tenants.

Business-technology incubator (BISC) as part of Industrial park Nova Gradiška – created with the purpose to contribute to sustainable regional development and improved competitiveness of the business sector. BISC offers a training centre for new technologies, a centre for engineering and technology services, a centre for business and marketing services and a business technology incubator.

Ruder Innovation – company specialising in the commercialisation of innovations and technology transfer owned by the Ruđer Bošković Institute. It is a type of link connecting science and technology with business and industry.

Technology Development Centre in Osijek (TDCO) – Tera Tehnopolis – established as a result of an initiative of the Josip Juraj Strossmayer University of Osijek, the City of Osijek and Osijek-Baranja County. Business incubation of technology-based enterprise, counselling and monitoring in regional economy are the main instruments of the implementation of TDCO's task.

Despite a number of universities and aforementioned institutions related to innovation, Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that SMEs from Continental Croatia, fall behind EU-average and country's average on almost all observed indicators. The underperformance is especially evident on the following indicators: EPO patent applications, R&D expenditures business sector, Trademark and design applications, Sales new-to-market/firm innovations, Public-private co-publications and Lifelong learning.

Demand-side barriers regarding the implementation of digital transformation

According to the EC's Digital Economy and Society Index 2018 (DESI), Croatia belongs to the low performing cluster of countries, ranking 22nd out of the 28 EU Member States. Over the last year, Croatia made slow progress on the DESI indicator "Integration of Digital Technology by businesses", and fell back from rank 17 to rank 21 because other countries were progressing faster.

Croatia's greatest challenge in digital remains its low performance in connectivity (DESI 2018, rank 27). Rural broadband connectivity and fast broadband coverage are limited, while prices for fixed broadband remain the highest in Europe. The incumbent (together with its subsidiaries) has a very high market share. Croatia could focus more on its low connectivity to achieve the Digital Agenda for Europe goals and in particular to reach fast broadband coverage of the entire population by broadband speeds of at least 30 Mbps. It would be beneficial to speed up the rollout of the approved EU-funded access and backhaul networks. In particular, the latter seems to be blocked at government level, with Croatia risking losing EU funds. In this context, alternative operators would benefit the most from backhaul deployment. In general, Croatia could be more vigilant in ensuring competition in the market. This would benefit consumers and stimulate investments in fast internet infrastructure and take-up of related retail products. If no action is taken, Croatia risks falling even further behind in the creation of a digital economy and society.

Croatia does not have a specific strategy for digitalisation of the economy. Two strategies partially cover this field: eCroatia that is oriented towards digitalisation of

public institutions and S3 strategy that recognises IT as a horizontal pillar but with no specific measures for developing IT sector. In spite of the relative absence of national digitalisation policies, Croatian companies are identified as medium performers (DESI 2018). Therefore it would, be even more beneficial for the Croatian economy if Croatia's companies could benefit from a targeted digitalisation strategy. In addition to absence of the national industry digitalisation strategies¹², some of the main challenges according to conducted interviews with Croatian Digital Innovation Hub, which take part in the Smart Factories in the new EU Member States project, are:

- **Skillsets:** With the wave of the automation and industrialisation, there is a need for the reskilling in order to keep track. Unfortunately, that process still has not begun in Croatia and specific skillsets required, such as robotic programming and Big Data Analytics are still required.
- **Capacities:** more than 99 % of the Croatian economy are small and medium enterprises mostly micro and the lack of their absorption capacities are recognised especially related to their knowledge, digital and management skills and competences.
- **Lack of awareness:** usually stems from insufficient knowledge and skills related to digital transformation and the opportunities it offers.
- **Lack of a common platform:** place where all the stakeholders relevant to the regional industrial ecosystem could meet and exchange ideas, collaborate, compete, and grow together. None of the currently present institutions (incubators, entrepreneurial support facilities, technology parks, cluster organisations, universities and RTO's, private companies, local/national governments) is able to offer a 'holistic approach' to digitisation as an industry-wide transformation process. Each of these actors offers only a partial solution to the general problem of digital transformation.
- **Scalability:** several enterprises are at the early stages of Industry 4.0 design and implementation. They have carried out some pilots on assembly lines, but the challenge is to scale up across enterprises and multiple factories.
- **Funding:** Funding is important but assumes more than just money. A lot of business management buy-in is required to sign up to Industry 4.0 roadmaps.

Structural macro-economic barriers

According to Eurostat data, Continental Croatia had an unemployment rate of 11.4 % in 2017, which slightly below the country's average. 4.4 % of total employed in the region work in high tech sectors. Despite a relatively high unemployment rate, many employers struggle to find qualified employees suiting their needs, especially in tourism related services during summer months. This is primarily the result of negative emigration trends of qualified (and young) persons to other EU countries. The impact of worker shortage has led to a slight increase in wages and an increase of quotas for labour force import. According to Eurostat, Croatia has the third highest level of youth unemployment in the EU. Even if having decreased from a peak of 49.9 % in 2013, youth unemployment (15-24) in 2016 was 31.1 %, still high in comparison to the EU-average of 18.7 %. Another problem is a high share of

¹² Following the September 2016 elections, the new Government was setting up a Central Office for the Development of the Digital Society. Digital Strategies are currently being updated and are to be released before the end of the year.

unemployed youth with upper secondary education and an increasing share of unemployed university graduates, suggesting a skills mismatch. Low job creation levels and a rigid labour market, amongst other things, have been blamed for the relatively more adverse effects of the crisis exerted on the young, whilst skills mismatch is another factor.

One of structural problems faced by the Republic of Croatia is the low volume of business investment in research and development, despite the abundance of existing tax reliefs. High value added services and knowledge-based services remain a negligible part of the export, while the skills and technological possibilities stagnate. This trend is reflected in Croatian export, technological success and ranking on the competitiveness scale compared with other countries in the EU.

Sources of available public finance for innovation projects

There are numerous co-financing opportunities supporting innovative projects, mostly coming from EU funds. However, there are no region specific sources of public financing that target innovative projects.

Operational Programme Competitiveness and Cohesion (OPCC) 2014-2020

– Allocation from European Regional Development Fund (ERDF) is around 4.3bn EUR, combined with 2.5bn EUR of Cohesion fund (CF), total OP budget is 8bn EUR. Under OPCC, about 57 % of ERDF resources are allocated to supporting Research and development (R&D), technological development and innovation, the digital agenda, the competitiveness of Small and medium-sized enterprises (SMEs), and the shift to low-carbon economy.

Additionally, entities from Adriatic Croatia can benefit from programs at EU level, such as Horizon 2020.

Croatian Bank for Reconstruction and Development (HBOR) – HBOR has several credit lines e.g. Inventions dedicated for innovative SMEs, which provide lower interest rates if certain conditions are met.

Croatian Agency for SMEs, Innovations and Investments (HAMAG-BICRO) – HAMAG-BICRO manages five programs to support public and private users in each phase of the innovation process:

- Proof of Concept (PoC) - The PoC programme supports innovation at the earliest stage of research to provide pre-commercial capital for technical and commercial verification of the innovative concept
- Development of knowledge-based enterprises (RAZUM) – RAZUM Programme provides start-up financing for newly established enterprises and initial financing for the development of new products or services to existing SMEs
- Programme for Development of Technological Infrastructure (TEHCRO) – the objective of the TEHCRO Programme is to increase the competitiveness of the Croatian economy through the development of effective business support institutions
- Research and Development Programme (IRCRO) – IRCRO supports SMEs to cooperate with the scientific research institutes in launching their own R&D activities
- Support to Technology Transfer Offices (TTO Programme) – The aim of the Program is to strengthen the role of the Technology Transfer Offices (TTO) at

universities and public research institutes in Croatia as the focal point for encouraging and implementing technology transfer activities.

Additionally, there are two acts in place, which support innovation projects – The State Aid for Research and Development Projects Act (Official Gazette 64/18) and Act on Investment Promotion (Official Gazette 102/15, 25/18). The acts provide tax incentives to enterprises with innovative projects under certain conditions.

Currently, The European Investment Fund (EIF) and the Ministry of Regional Development and EU Funds of Croatia (MRDEUF) have presented a signed agreement to establish the Croatian Financial Instrument 'ESIF Venture Capital Fund'. The ESIF Venture Capital Fund instrument has an Acceleration compartment that will turn investments into risk capital funds targeting local small and medium-sized enterprises with high growth potential.

Sources of private finance for innovative projects

Croatia does not have a local venture capital fund. So far, Croatian start-ups had to attract funding from international investors, with investors ranging from Y Combinator to 500 Start-ups. There are several private equity funds operating in Croatia but they usually invest in enterprises in later stages of development, and not innovation projects.

Positive and negative examples of initiatives undertaken in the region

One of the successful stories funded by PoC (managed by HAMAG-BICRO) was an IPA project worth nearly 5M HRK for the development of a novel method of rapid detection of pathogens and tumour cells for use in clinical practice - Rapid Cell. Ruđer Bošković Institute (RBI) conducted the research in collaboration with the Faculty of Food Technology and Biotechnology of the University of Zagreb and SEMGEN Ltd. The objectives of this action are:

- Strengthening of the ecosystem of SMEs springing up after dissolution of principal national pharmaceutical company Pliva Inc.
- Establishing the credibility and feasibility of Knowledge Transfer actions between RBI, University of Zagreb and those SMEs
- Marketable system for RapidCell.

Except for medical diagnosis, this method will find its application in the food and pharmaceutical industry that will be able to use the research results in the quality control processes and the design of new production processes.

Moreover, Croatian researchers have conducted many studies and infrastructure projects in the field of biomedicine and in the field of biosciences in general. The funding was usually derived from a number of pre-accession funds and programmes. Further investment in biomedicine is additionally supported by the fact that biomedicine is the most productive research field in Croatia.

A joint project named "The use of innovative technologies for isolation of bioactive compounds from organic waste in wine production" of Faculty of Food Technology and Biotechnology in Zagreb (PBF) and Agrolaguna, where PBF was leading the project and Agrolaguna contributed as an industrial partner to the scientific institution. The project was nominated as a finalist in RegioStars Awards for 2016 in the category: Sustainable growth – circular economy. It researched the additional financial potential and the possibility of isolating bioactive compounds from husk that remains as a by-product of wine production, as well as positive effect to

the ecological aspects of wine production process. This cooperation enabled the development of new ecologically friendly solutions that allowed for the use of biological potential in organic waste in order to reduce, or even remove their effect on the environment. Considering the fact, that most countries in the region have a developed wine industry and have problems with grape and wine waste management, the results of this research, through the development and application of new technologies and knowledge, can potentially have a positive influence on productivity of companies and the economy of the entire region. This project contributed to strengthening of the scientific and research capacities of Faculty of Food Technology and Biotechnology through the obtaining new equipment, as well as to a more efficient transfer of knowledge from the scientific-research sector to economy.

On the other hand, even though Croatia has many innovative initiatives and support from public and private institutions, as well as the EU, there are some negative experiences in projects where the State plays a vital role in project implementation.

For the last nine years the Srebrnjak Children's Hospital in Zagreb, Croatian and European Centre of Excellence for Allergies, works on the Centre of Competence for Translational Medicine. The centre aims to integrate different areas of top paediatrics and clinical trials with basic biomedical research units in order to help alleviate chronic childhood illnesses and develop innovative medicines and diagnostic procedures. They announced the start of construction in 2015 and completion by the end of 2017. However, none of this has happened even though the EU has approved 48M EUR, and foreign experts rated the project as excellent. The project could fail due to lack of organisation and support at project coordinator and the state level (i.e. decision on the location of the hospital, long period for the project approval on the government level, etc.), as well as lobbies from competing hospitals. Even though this project has the status of the strategic importance for Croatia, it could fail to fulfil the deadline for the project completion set by the EU and lose the funds.

2.2.3 Cyprus

The Republic of Cyprus is one of the smallest Member States of the European Union. According to the Statistical Service of the Republic of Cyprus, in 2016 the total number of enterprises in Cyprus was 88,689 of which 99.9 % were SMEs. According to the 2017 SBA Fact, SMEs account for more than 70 % of total value added and more than 80 % of all jobs. This is well above the EU average (more than 15 percentage points above) for both SME value added and employment.

Cyprus hosts three public and five private universities. The University of Cyprus and the Cyprus University of Technology rank second and third among the best institutions from new EU member states.

Cyprus host various innovation- driving institutions and facilities, including:

- Chrysalis Leap, a Cleantech Accelerator aiming to create opportunities for entrepreneurs through training and coaching, design. They also run innovation events, and support startups get funded. They partnerships with Climate KIC, participate in a Regional \innovation Scheme for European Institute of Innovation & Technology (EIT).
- Gravity Ventures which is a cutting-edge, venture building focusing on building startups from early-stage to mature ventures by assisting in all the necessary steps from idea validation to funding.

- IDEA Programme which aims to support startups with free accommodation, business support, training and advice to become self-sustainable in the market.
- Computation-based Science and Technology Research Centre (CaSToRC) which is one of the research centres of The Cyprus Institute. The Centre is being developed jointly with the University of Illinois, and in particular, with its [National Centre for Supercomputing Applications](#) (NCSA) and it was officially launched in February 2009. The Centre is actively involved in research projects relating to improving the computing infrastructure of the Eastern Mediterranean region. One of the current strategic goals of CaSToRC is to be engaged with the business and startup community of Cyprus aiming to support them in their digital transformation.
- Research Centre on Interactive Media Smart Systems and Emerging Technologies (RISE) which aims to become a Centre of Excellence hub across the three continents bordering Cyprus, facilitating thus the local scientific, technological, and economic growth of the region. It identifies the potential of Interactive Media to bring together several scientific areas, yielding applications in the priority areas of the Smart Specialisation Strategy of Cyprus. Therefore, research in RISE integrates the Visual Sciences, Human Factors and Design, and Communications and Artificial Intelligence, in a tight synergy that provides a unique interdisciplinary research perspective that emphasizes an “Inspired by Humans, Designed for Humans” philosophy.
- KIOS Research and Innovation Centre of Excellence (KIOS CoE) which operates within the University of Cyprus. The KIOS CoE conducts cutting-edge multidisciplinary research and innovation in the area of Information and Communication Technologies (ICT) with emphasis on the Monitoring, Control, Security and Management of Critical Infrastructure Systems.
- EMPHASIS research centre, an interdisciplinary research Centre at the University of Cyprus, focusing on Key Enabling Technologies in micro/nano-electronic devices, sensors, photonics and microwave circuits and systems
- The Robotics Control and Decision Systems laboratory of the Cyprus University Technology which focus on multi-robot motion task planning with applications to mobile, aerial, underwater and underground robots.
- CYRIC which is the only certified Business Innovation Centre (BIC) in Cyprus, certified by the European Business Network. They aim to become an important regional Centre developing disruptive products for the world markets and providing services to the industry. The Centre have access to a wide range state of the art Test and Measurement Equipment as well as at cutting edge technology.
- E-health laboratory, which operates within the Department of Computer Science of the University of Cyprus. The objective of the eHealth lab is the development of intelligent medical diagnostic systems integrating a great variety of distinctly different technologies such as signal/image/video acquisition, preprocessing, feature extraction, dimensionality reduction, data mining and risk modelling, clinical decision-making, and mobile health support and functionality.

The strengths and weakness of the Cypriot entrepreneurship ecosystem are highlighted in the Global Entrepreneurship Monitor 2016/2017. The most important strengths of Entrepreneurship Ecosystem of Cyprus are physical infrastructures and access to commercial and legal infrastructure. The mean score of the physical

infrastructure in Cyprus is close to the average value recorded in Europe, whereas Cyprus' commercial and legal infrastructure score is above the corresponding European average value. The most critical weakness are limited entrepreneurial education at primary and secondary education levels and the lack of government support and initiatives through entrepreneurship programs, and a financial environment for entrepreneurship.

According to the Regional Innovation Scoreboard Cyprus is a Moderate Innovator. Due to the predominant of non R&D intensive services sectors in the economy – the manufacturing only accounts for about 5 % of Gross Value Added - the R&D intensity of Cyprus is the lowest in the EU at only 0.5 % of GDP. The business expenditure for Research and Development reached 0.10 % of GDP in 2015. The business enterprise sector, Information and Communication Technologies accounts for the core of the research activity with expenditures of EUR 10.1m, while the contribution of the manufacturing industry amounts to EUR 7.3m. In the services sector, the ICT sector had also presented a notable increase from EUR 6m in 2013 to EUR 8m in 2014 and EUR 10.1m in 2015.

The Smart Specialisation Strategies are the European national/regional innovation strategies which set priorities to build competitive advantage by developing and matching research and innovation own strengths to business needs to address emerging opportunities and market developments coherently, while avoiding duplication and fragmentation of efforts. In Cyprus, the aim of the Smart Specialisation strategy is to enhance the effectiveness of the Research, Technology Development and Innovation system. The priority sectors identified through the Smart Specialisation strategy of Cyprus are:

- Tourism: sustainable tourism, alternative forms of tourism, digital tourism applications, management and promotion of tourism product
- Energy: renewable forms of energy, solar energy, Solar-thermal technology Solar Photovoltaic, Technologies for Solar Heating and Cooling, energy storage and transfer
- Agriculture –Food Industry: Agricultural and livestock production, Agriculture, Food Security and Climate Change
- Construction industry: Sustainable Urban Development, Sustainable Construction, Existing Building Stock, Innovative and Intelligent Materials and Reuse of Building Materials, Cultural Heritage
- Transportation: Marine, Shipping, Intelligent Transport Systems, road freight. Health: e-health, prognosis – prevention and treatment of diseases, health pharmaceutical industry.

In addition, the following important sectors were identified as important sectors of horizontal character:

- Environment: Climate Change, pollution, Eco Systems, Eco-Innovation, Water Resources
- ICT: ICT Application, Future Technologies.

Demand-side barriers for digital transformation

Currently, Cyprus ranks 21st in Digital Economy and Society Index (DESI). Overall, Cyprus is progressing slowly but steadily. It shows improvement in all aspects of

DESI. The biggest barrier for the digital transformation of the country is the low performance in digital skills.

In the human capital sector, Cyprus' performance is below the EU average, since only 50 % possessed at least basic digital skills in 2017. Nowadays, digital skills and competencies are needed for nearly all jobs where digital technology complements existing tasks, and shortages can be an important barrier to the country's economic development. Moreover, Cyprus has a low share of Science, Technology, Engineering and Math (STEM) graduates (9.8), ranking lowest among EU countries. The country also has a lower share of ICT specialists in the workforce (2.2 %) than the EU average (3.7 %).

Furthermore, Cyprus is progressing slowly in the field of the integration of digital technologies by businesses. Companies do engage in the use of social media and do trade online, but are less inclined to take up new technologies such as Cloud and RFID. SMEs' online selling services declined, to 11.4 % from 12.4 % the previous year. On the other hand, e-commerce turnover increased from 4.7 % to 6.3 %.

Structural macro-economic barriers to the implementation of industrial needs

After Cyprus exited its 10bn EUR bailout in 2016, it showed an enviable growth. The GDP of Cyprus increased from 18.219bn EUR in 2016 to 19.214bn EUR in 2017, while the government's debt declined from 106.6 % of GDP in 2016 to 97.5 % of GDP in 2017. The Industrial Production Index of Cyprus in January 2018 increased by 10 % compared to January 2017. Unemployment in Cyprus dropped to 11 % in Q4 2017, from 17,4 % in 2013, after the crises.

The growth potential of the economy is hindered by the surge in NPLs which has dried up credit supply resulting to limited access to finance. As a result, the overall performance of Cyprus in access to finance is still the third worst among its EU peers, despite the recent improvements in bank lending since 2015. The lack of traditional bank loan and alternative sources of financing such business angels funding, venture capital, equity funding and crowdfunding put significant constrain on SMEs.

Sources of available public finance, encompassing national, regional and EU support for innovation projects

The innovation projects in Cyprus are supported by various programmes; both structural and European. The structural programmes are the Framework Programme RESTART 2016 – 2020 which is managed by the Research Promotion Foundation and the Programme Strengthening Entrepreneurial Innovation which is managed by the Ministry of Energy, Commerce, Industry and Tourism. Both programmes are part of the Operational Programme "Competitiveness and Sustainable Development 2014-2020", which is the developmental strategy of Cyprus that utilizes the resources of the European Regional Development Fund (ERDF) within the framework of the Priority Axis 1: "Strengthening the Competitiveness of Cyprus Economy".

The Framework Programme RESTART 2016-2020 comprises a multi-annual development framework of programmes for the support of Research, Technological Development and Innovation in Cyprus. The vision of the Framework Programme RESTART 2016-2020 is to promote the field of Research, Technological Development and Innovation (RTDI) as a basic factor for Cyprus' economic development, contributing to dealing with the basic economic and social challenges and the development of conditions of sustainable growth, in accordance to the "Europe 2020" strategy for smart, sustainable, inclusive growth.

SMEs active in the research and innovation field are eligible to participate in all the sub-programmes of RESTART. Furthermore, many sub-programmes exclusively target SMEs. As a result, a company can apply for any of the sub-programmes of RESTART without limiting itself by its specific needs. The following sub-programmes are offered to the companies within the RESTART Framework.

- Research in enterprises
- Research in newly established enterprises
- Investigation of industrial application technology, know-how
- EUREKA and EUROSTARS
- DIDACTOR (PhD holders)
- SME Instrument – Second Opportunity
- Innovation vouchers
- Participation in events for international networking purposes
- The commercialisation of research results by the enterprises

“Strengthening Entrepreneurial Innovation Programme” aims to support and strengthen startups and existing companies, which invest in a new or significantly improved development of product, service or process (innovation). Particular emphasis is placed on the development of products, services, and processes that may be protected by patents or industrial designs and can be successfully introduced to the international markets.

Innovation projects in Cyprus are also supported through Horizon 2020, the EU’s biggest research and innovation programme ever introduced with nearly EUR 8.0bn of available budget from 2014 to 2020. Horizon 2020 is seen as the funding instrument for implementing other European initiatives, such as the Innovation Union or Europe 2020, which are aimed to secure Europe’s global competitiveness. It is.

Horizon 2020 stimulates the SME participation across the whole programme, but with a particular focus on close-to-market support. It is expected that European SMEs will absorb EUR 8.6bn. This means that SMEs are directly encouraged for Research and Innovation activities mostly as part of a consortium. The SMEs can claim grant up to EUR 5m. The percentage of the expenses covered by the subsidy depends on the type of the action (e.g. Innovation action, research and innovation action, coordination and support actions etc.) and ranges from 70 % - 100 %.

Cypriot organisations have been actively participating in Horizon 2020 programme by extensively submitting their applications. Currently, Cyprus ranks first as regards the per capita attraction of funds from Horizon 2020, meaning that for every euro that Cyprus has contributed to the Programme, it managed to win more than three euros, thus ranking first among the EU member states.

Until 2016, 1,301 proposals that include at least one Cypriot organisation were submitted. The total number of Cypriot organisations participating in these proposals is 1,585, of which 591 organisations were SMEs. 141 proposals were successful.

SME Instrument is one of the financial initiatives of Horizon 2020 that is designed exclusively for Innovative SMEs, which cannot have access to financing due to their high-risk nature. With a budget of EUR 3bn allocated from 2014 to 2020, SME Instrument is expected to support more than 7,500 companies.

SME Instrument consists of three phases. At Phase 1, successful SMEs receive EUR 50,000 for development of a business plan. At phase 2, SMEs receive up to EUR 2.5m (EUR 5 m for clinical research for the validation of biomarkers and/or diagnostic medical devices) for the further development and commercialisation of their product, service, and process. At phase 3, SMEs receive business support in the form of consultancy services with the purpose of access to risk finance. In Cyprus, only seven SMEs were successful in receiving a grant through SME Instrument as coordinators.

Sources of private sector finance

There are **financial instruments** available to support digital transformation, which originate from private funding:

- EIB loans are offered to the Cypriot SMEs by the majority of the Cypriot Banks aiming to support SMEs and Midcaps with investment needs of up to EUR 25m. By 2016, EIB signed a total of EUR 615m with about EUR 220m of that money already benefiting some 240 new investments.
- The Cyprus Entrepreneurship Fund is a fund established by the Republic of Cyprus aiming to support and strengthen entrepreneurship in Cyprus through the facilitation of access to finance for SMEs. The amounts allocated from the Cypriot government to CYPEF were funded by the EIB while EIF manages the fund. Currently, the fund is being offered by the Bank of Cyprus and the Ancoria Bank.
- InnovFin SME Guarantee is one of the integrated financial tools of the "InnovFin - EU Finance for Innovators," which is a joint initiative launched by the EIB Group in cooperation with the EC under Horizon 2020. InnovFin financing products, offered by EIB Group, cover the entire value chain of research and innovation investments aiming to support enterprises of various sizes. Currently, the InnovFin guarantee product is being offered by the Russian Commercial Bank (RCB). In essence, it provides guarantees and counter-guarantees on debt financing between EUR 25,000 and EUR 7.5m to improve access to loan finance for innovative SMEs and small midcaps. The financial intermediaries are guaranteed or counter-guaranteed against a portion of their potential losses by the EIF.

Accelerators/Venture Capital/Business Angels

There are currently two accelerators/incubators offering support to entrepreneurs in the form of equity, management training, office space and networking opportunities; the Gravity Venture and the IDEA accelerator. There are also other accelerators which support the startups and entrepreneurs mainly through coaching and training such as Chrysalis Leap and ARIS programme. There is only one Angel Investment Network, the Cyprus Business angels Network, which connects innovative, fast-growing companies to equity finance through the membership of experienced angel investors. Emergo Ventures is a venture capital company, which provides startup or growth capital to business with innovative offerings addressing unmet needs in almost any sector.

Examples of initiatives undertaken in the region

The last decade public as well as private initiatives reinforce the startup community as well as the innovative companies in Cyprus. As a result, Cyprus accounts few successful examples of innovative companies/startups. However, two of the

examples presented in the report concerns successful startup companies with Cypriot founders, which have been established in Greece instead of Cyprus due to the lack of funding and skilled programmers.

Proto.io is one of the success stories emerged from the startup community of Cyprus. Proto.io is an application prototyping platform launched in 2011 and development by the Labs Division of SNQ Digital. Originally designed to prototype on mobile devices, Proto.io has expanded to allow users to prototype apps for anything with a screen interface, including [Smart TV's](#), [digital camera](#) interfaces, [cars](#), [airplanes](#), and [gaming consoles](#). Proto.io utilizes a drag and drop user interface (UI) and does not require [coding](#). The company is based in the USA and operates in Cyprus. They account for more than 600,000 users, and their clientele includes Disney, Nickelodeon and ESPN.

Avocarrot is a successful startup founded by four Cypriots and acquired for 20.000.000 by Glispa Global Group in 2016. However, the lack of funding and talent in Cyprus was the main reasons which the founders decided to establish their company in Greece instead of Cyprus. The company is specialised in native ads for mobile applications. They offer advantages for both publishers and advertisers boosting engagement and click rated for both entities. Avvocarrot was recognised by Google as one of the eight best companies for entrepreneurs. Avocarrot's acquisition was the largest tech startup exit to date in Greece.

2.2.4 Czech Republic

2.2.4.1 City of Prague

The city of Prague, situated in the north-west of the country on the Vltava river, is both the capital of the Czech Republic and one of its regions. The great number of public institution resides in Prague as well as the president, parliament, government and many more. On top of that, it is an administrative centre of Central Bohemia Region. With its population of around 1.3M people, it is the biggest city in the Czech Republic (it represents 11.5 % of its total population) and in the top 15 of the biggest cities in the European Union.

Prague has a very specific position amongst other regions and cities in the Czech Republic. It is a centre for economy, politics, foreign relationships, education, culture, etc. Thanks to concentrations of these functions, Prague is leading in almost every structural indicator that affects the innovation environment and competitively.

The city of Prague is the only municipal region in the Czech Republic. Its high urbanisation and close distance between innovation actors and supporting institutions and organisations have a strong agglomeration effect. The concentration of services and functions makes the region very attractive for employers who can satisfy their demand for professional personnel. Prague also attracts a large number of workers from other regions as well. The labour market is very dynamic with high professional mobility. All these factors combined with diversification of labour market and high investment activity result in a very low rate of unemployment.

One of the key enablers of dynamic innovation potential is a highly educated workforce. The education level of Prague's population is above average in the Czech Republic and a number of people with university and high school diploma is increasing every year. The positive educational structure is multiplied by the concentration of universities, colleges and institutions of higher education. Relatively high share of

students in natural and technical sciences has a positive effect on the development of innovation potential.

There are more than 30 institutions of higher education in Prague. They are private, public, state and offices from foreign colleges. The ones that invest in research and development the most and also have the highest academic results are:

- Charles University in Prague
- Czech Technical University in Prague
- University of Chemistry and Technology in Prague
- Czech University of Life Sciences Prague

There are also many research institutions managed by the Academy of Sciences of the Czech Republic. To name the most relevant: Institute of Organic Chemistry and Biochemistry, Institute of Physics, Institute of Molecular Genetics, Institute of Microbiology, Institute of Physiology, J. Heyrovský Institute of Physical Chemistry, Institute of Macromolecular Chemistry, Institute of Experimental Medicine, Institute of plasma physics, Institute of Chemical Process Fundamentals, Institute of Theoretical and Applied Mechanics.

Dynamics of economic performance and characteristic structure of the economy in the region (strong position of tertiary and quaternary sector, therefore branches with high added value) have positive impact on macroeconomic position of the Prague compared to other regions (especially in the production of gross domestic product where it is nearly double the average of other regions). Good economic performance and unique macroeconomic position of the region is also influenced by the concentration of multinational corporation that resides in Prague as well as many public institutions and its tourism attractiveness.

The Economy structure also affects the concentration of technology centres. Although it ranks 5th amongst region in the Czech Republic regarding investments into technology centres, Prague has successfully created the most of new open positions. Factors that caused the concentration are mainly supply of well-educated and highly skilled labour workforce and developed transportation infrastructure.

Aforementioned economic performance, the structure of economy and innovation environment also correspond with direct foreign investments and also with investments allocated from venture capital funds. The motivation for foreign investors to invest in Prague is mainly strong social capital, the purchasing power of the population and development of the service industry. These factors attract most of the foreign investments. Fact that some companies are multi-regional but are based in Prague means that while the profit may originate in another region it is reported in Prague which is decreasing their macroeconomic position.

One of the outcomes of Prague's concentration of tertiary and quaternary functions is also its strong position in the field of research and development. There is located nearly one-third of the R&D institutions located in the Czech Republic. Investments and number of employees in R&D are closely related to this fact. Prague is also specific in the number of people employed in the public sector of R&D – the share is higher than in the private sector, which is uncommon in the Czech Republic.

Following list is an example of private organisations that focuses heavily on research and development:

- Life sciences: chemical and pharmaceutical industry (Zentiva, Sanofi-aventis, AstraZeneca Czech Republic, PRO.MED.CS Praha, Intherpharma, Pharmaceutical research Associates CZ), specialised medical equipment and tools (UJP Praha, GlaxoSmithKline, LASAK), healthcare care
- Production specialised in electronic and optical equipment (Siemens) and manufacturing of transportation vehicles (Stadler Praha, TÜV SÜD Czech, Railway Research Institute) especially of planes and avionics (LOM Praha, Czech Aerospace Research Centre, e4t electronics for transportation)
- ICT, marketing and communication, specifically information and communication technology (T-mobile Czech Republic, Seznam.cz), financial services (Komerční Banka,), IT governance and security (Siemens, Pike Electronic, TIC Telekomunikace), specialised software development (CA CT, Cesnet, K trade consult)

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. Prague has identified the following strategic goals:

- **Environment stimulating innovations and partnerships.** Low level of cooperation between subjects in the innovation system results in its low overall performance. A key challenge of Prague in the development of competitiveness of its innovation system is building long-term partnerships between the public sector, private sector and academia.
- **Enabling creation and development of knowledge-intensive companies.** The initial phase after the company is created is critical for its future development. Low competence of entrepreneurs, lack of capital for development and inability to invest in innovation activities often leads to stagnation and shutting down of the business. In order to support newly created businesses, Prague has decided to create a program for their financial support, increase availability and quality of services for innovation and invest in its innovation infrastructure.
- **More intense involvement of local personnel in the knowledge-based economy.** According to international researches knowledge, skills and competencies of students are decreasing. Prague's goal is to create an environment where talented students and scientists could develop more their capabilities and be the inspiration for others through interventions in the field of supporting talented individuals.
- **Increasing intensity of internationalism in the research and development.** Despite Prague's position in the research and innovation, the system of the Czech Republic, its international position and level of internationalisation of innovation activities do not correspond to its position. The goal of this initiative is to increase cross-boarders mobility, propagate its research and development activities abroad and remove barriers for qualified personnel coming from abroad.

Demand-side barriers regarding the implementation of digital transformation

Development of innovation environment of the entrepreneurship sector in Prague could be further supported by European Union's Structural funds but it is very limited by fact that Prague is not ranked within Goal 1 of the European structural policy.

Project activities of Prague's SMEs were evaluated poorly due to this limitation. Thanks to the level of development of the entrepreneur's sector, a high concentration of R&D organisations, universities and macroeconomic characteristic the need for the development of innovation infrastructure is not so strong as amongst other regions. What Prague lacks nowadays is a regional development agency and strategy to support the development of innovation centres and start-up incubators.

Many new companies in the knowledge-intensive fields do not survive their initial phase. Prague does not have a cohesive strategy and tools for their financial support. On the other hand, the city does not usually cooperate with investors and lacks experience in the facilitation activities related to supporting of potential investors.

Involvement of public and private organisations in international research programmes is relatively high compared to the rest of Czech Republic, however, the local subjects are rarely in the position project coordinator and their role compared to other subjects from E15 is unsatisfactory.

Structural macro-economic barriers

Although the percentage of people with a university degree is high in Prague their quality is getting lower. On the one hand, the fact that students often don't have sufficiently developed their horizontal skills is lowering their flexibility on the labour market and on the other hand there are very limited possibilities for the most talented students who often choose to go abroad. Therefore there is an inconsistency between the structure of absolvents and the needs of the economy.

Prague has also failed in creating a welcoming environment for international talents. Support of specialists from other countries is one of its RIS but it will take some time for the changes to take effect.

Qualification of personnel and the overall situation on the labour market have an impact on the cost of the workforce. It is relatively high compared to other regions of the Czech Republic and therefore it is difficult for companies to attract new employees.

Sources of available public finance for innovation projects

Enterprises ranging from startups, SMEs and large enterprises can apply for funding on the regional, national and European level.

The regional funding is represented by the budget of the City of Prague and by the budget of its districts (there are 57 of them). The City of Prague has planned expenditure (for the year 2019) of 56 bil. CZK (7 bil. CZK of which are capital expenditure) and its districts combined around 15 bil. CZK. Districts often do not coordinate its activities with the city, which is causing inefficiencies in their investment activities. Moreover, the city budget is burdened with many mandatory expenses, which is why this funding option is not used very frequently for innovation projects.

There are various funding programs from the European Structural and Investment Funds (ESIF) in the period of 2016 – 2023. Organisations from the City of Prague can apply for one of the following programs, managed either by European Regional Development Fund or by European Social Fund:

- Operational Programme Prague – Growth Pole of the Czech Republic, allocation of this programme is 201,6 mil. EUR

- Operational Programme Research, Development and Education, allocation of this programme is 2.77 bn EUR (of which 220M EUR is allocated for projects in Prague)
- Operational Programme Employment, allocation of this programme is 2.15bn EUR (of which 100M EUR is allocated for projects in Prague)
- Integrated Regional Operational Program, allocation of this programme is 4.64bn EUR (of which 24M EUR is allocated for projects in Prague)

or managed by Cohesion Fund for the Czech Republic:

- Operational Programme Environment, allocation of this programme is 2.64bn EUR (for the whole Czech Republic)
- Operational Programme Transport, allocation of this programme is 4.70bn EUR (for the whole Czech Republic).

The main objective of the Operational Programme Prague - Growth Pole for the programming period is to ensure the fulfilment of thematic objectives. It is necessary to ensure effective implementation of investments in Prague, which will lead to increased competitiveness of Prague as a development pole of the Czech Republic and to ensure the quality of life of citizens.

The key principle of the Operational Programme Research, Development and Education (OP RDE) is the development of human resources for the knowledge economy and sustainable development in socially cohesive society and it is supported by interventions in the context of several priority axes. This is followed by the theme of support for quality research, for which the qualified workforce represents the key input factor.

The aim of the Operational Programme Employment (OPE) is to improve the human capital of the population and public administration in the Czech Republic, i.e. the basic elements of competitiveness.

Integrated Regional Operational programme (IROP) follows the seven regional operational programmes and partly the Integrated Operational Programme of the 2007-2013 programming period. The priority of IROP is to enable a balanced territorial development, improvement of the infrastructure, improvement of public services and public administration and ensuring sustainable development in municipalities, cities and regions.

The main objective of the Operational Programme Environment (OPE) is to protect and ensure a quality living environment for the population of the Czech Republic, to support resource efficiency, eliminate negative impacts of human activities on the environment and to mitigate climate change impacts.

Through Operational Programme Transport 2014-2020 it is possible to finance infrastructure for rail transport, combined freight and urban public transport, the road infrastructure owned by the state (motorways and main roads), the public infrastructure for clean mobility (charger for electric vehicles and filling stations for alternative fuels), modernising rolling stock fleet and cargo vessels.

There are following funding options on the national level that exists thanks to National Initiative Industry 4.0:

- National innovation fund. It is intended to activate the venture capital market. It takes the form of reversible investment into young and innovative enterprises.

Supported projects are usually in the proof of concept and prototyping stages in the high-tech fields with long ROI.

- Investment incentives law. It provides an opportunity for companies in the manufacturing industry, strategic services and technology centres to apply for lower taxes and support for creating new jobs and increase qualification of personnel.
- The trio, Gama and Epsilon. Ministry of Industry and Trade administer Trio while Technology Agency of Czech Republic manages Gama and Epsilon. The goal of all three initiatives is to increase utilization of programs targeted to applied research and development.

Sources of private sector finance for innovation projects

Prague is a start-up centre of the Czech Republic (although internationally successful entrepreneurs are located in other cities as well). As such, it offers many possibilities to support young business. There are many business accelerators and capital funds both domestic (Rockaway Capital, Credo Ventures) and international (3TS Capital Partners, CEE Equity Partners Ltd).

Examples of start-up accelerators and coworkings that offer mentoring are:

- CzechAccelerator
- Node5
- StartupYard
- TechSquare
- Impact Hub

There are also accelerators associated with universities that support projects of its students:

- InovaJET (Czech Technical University in Prague)
- Point One (Czech University of Life Sciences Prague)
- xPORT VŠE (University of Economics, Prague)

Positive and negative examples of initiatives undertaken in the region

The City of Prague is home to many successful companies and institutions. A great example is Czech Institute of Informatics, Robotics and Cybernetics (CIIRC) that was created with the combined effort of the city representatives, Ministry of Industry and Trade and Czech Technical University in Prague. This institute is at the forefront of activities in the area of Industry 4.0 in the Czech Republic. It actively promotes international cooperation in the field and synergies between the private sector and academia. It has opened the Testbed for Industry 4.0 as a new research and experimental workplace for testing innovative solutions and processes for smart factories. CIIRC also carries out several lines of relevant research in the fields of intelligent systems for industry, big data, cloud computing and machine learning, among others.

Prusa Research is another worth mentioning case. Prusa Research is a pathfinder in 3D printing since 2012. The company focuses on manufacturing of 3D printers and is a global leader in its category. According to 3D Hubs, Prusa i3 is the most used 3D printer globally, thanks to the innovative approach through the full metal nozzle and

the heated bed. Prusa Research is in the process of automation and robotisation of production.

Initiatives that the city undertakes are usually planned very well. The biggest issue is underdeveloped infrastructure (for example there are several bridges in the critical state) and the complicated process of developing new buildings (both residential and office). These factors are slowing down the potential of the city and should be addressed in order to keep the high pace that the city has set.

2.2.4.2 South Bohemian Region

South Bohemian Region is located in the southern part of Bohemia (a historical land that spans on the western half of the Czech Republic). It borders Austria and Germany to the south. With its population of around 650 000 people, it ranks amongst average in the Czech Republic. The capital city of South Bohemian Region is České Budějovice which is also a capital of the district with the same name. The other districts are Český Krumlov, Jindřichův Hradec, Písek, Prachatice, Strakonice and Tábor.

The region is characteristic by its preserved natural environment, low population density and amongst other regions quite higher percentage of agriculture in the economic structure. The horizontal location of the region was significantly improved after joining the EU due nearby location of developed regions of Austria and Germany. Its vertical location (significance amongst other regions of the Czech Republic) was improved as well with the increasing cross-border cooperation with aforementioned regions of Austria and Germany mainly in the area of light manufacturing industry and tourism.

South Bohemian Region produces 5 % of the national gross domestic product which is 82.7 % of the average. Its unemployment rate is almost lowest in the Czech Republic (2.01 % compared to 1.99 % of Pardubice Region). On one hand, it represents difficulties for employers when searching for new employees but on the other hand, it is a strong argument for digitising and automation in production.

There are represented both the progressive branches of industry (IT, energy, electrical engineering, components for the automotive industry) and the traditional one (for example agriculture, food industry, and textile) with strong innovation potential.

The region is home to many public research and educational organisations and diversified manufacturing industry that spans across the whole region. Except for these three universities and colleges, there are 20 various higher vocational schools in the region.

- University of South Bohemia in České Budějovice consists of eight faculties that cover humanistic topics (i.e. education, arts, theology) and those relevant to dominating industries in the region (agriculture and Faculty of Fisheries and Protection of Waters). There is also eight affiliated institutes of The Czech Republic Academy of Sciences
- Faculty of management of the University of Economics in Prague (subsidiary located in Jindřichův Hradec) provides an education at the bachelor, master and doctoral levels both in full-time and combined forms. It offers student programmes focused on the private sector, management in public service and information management

- Institute of Technology and Business in České Budějovice focuses on the fields of transportation and construction. It formed a consortium to support a technical education in the region (its activities are for example knowledge transfer, sharing of technical equipment and grants for talented students).

There are 123 research and development institutions (both from the public and private sector) that employ combined 3 591 employees (3.6 % of the Czech Republic R&D workforce). The public sector accounts for slightly more than 50 %. Expenditure in R&D is steadily growing but mostly in the private sector (in the year 2016 private sector accounts for 1.86bn CZK and public accounts only for 0.88bn CZK).

Key research and development organisations are:

- The Biology Centre of the Czech Academy of Sciences that focuses mainly on fundamental and also applied research, and provides education in a number of biological disciplines
- The Třeboň department of the Institute of Botany of the Academy of Science of the Czech Republic which performs primarily basic research in the fields of plant ecology and taxonomy, ecology. Its secondary focus is on applied research projects
- The Centre of Algal Biotechnology is internationally recognised centre for research of microscopic algae and their use in food and feed industries and in human and veterinary medicine
- South Bohemian Research Centre of Aquaculture and Biodiversity of Hydrocenoses, which has an objective of fully understanding the ongoing processes in freshwater ecosystems.

The regional innovation infrastructure consists of science and technology parks, academic and university research centres and business development agencies. The most relevant for support of digitising are:

- South Bohemian Science and Technology Park offers an environment in a form of equipped laboratories, offices, seminar rooms or technology halls, and also provides to settled enterprises all that they need for their activities
- South Bohemian Agency for Support to Innovative Enterprising is a non-profit enterprise founded by the South-Bohemian Chamber of Commerce. Its activities include the application of research and development results in practice and support of interested entrepreneurial subjects
- Technologicke centrum Písek operates for 5 years and besides offering an office space, workshops for light manufacturing is mainly dedicated to offering services related to data center with focus on ICT, Cloud Computing and IoT.

Despite the number of different organisations and institution dedicated to education the key topic of the region is lack of technically skilled and educated personnel. A regional innovation strategy of smart specialisations (RIS) tries to address this issue. Its first priority area is dedicated to personnel:

- **Increasing quality and availability of human resources.** The goal is to prepare potential employees to ever-growing requirements of the regional labour market and keep them within the region. In current knowledge-oriented economy, highly competent and skilled personnel represents a huge competitive advantage.

- **Cooperation and technology transfer.** The main target of this specialisation is to support a cooperation of private companies, research institutions and municipalities in order to boost their competitiveness and help grow technological progress on the municipal level (eGovernment, Smart City, Smart Village).
- **Support of entrepreneurs.** This area is targeted towards the creating support tools that will assist the initiator of the innovative idea with creating a company, development of highly professional personnel, producing the product and selling it on foreign markets.

Demand-side barriers regarding the implementation of digital transformation

Companies within the South Bohemian Region are generally slower in the adoption of new technologies especially in the traditional branches of industry (agriculture and food industry) that results in lagging behind the leaders. In general, there is also a lower percentage of entrepreneurs in the population. Both of these factors represent significant barriers to the implementation of digital transformation.

Cooperation with cross-boarders subjects has untapped potential as well. SME should be more collaborative with project realisation and knowledge transfer as well. Reason for this could be an underdeveloped state of transportation (road and railway) and logistical infrastructure that is slowing down development of the whole region.

While there is a good network of innovation infrastructure, the companies often do not use it because they do not know about it. The reason are poorly financed and executed promotion and marketing activities related to joint research and development.

Key enablers of innovation – industrial parks are not used to its full potential in the South Bohemian Region. There is none in the close proximity of České Budějovice.

In order to help with the implementation of digital transformation, the region should focus on investments into transportation infrastructure to enable cross-border cooperation with foreign enterprises and SMEs. Then it should focus on building a coherent innovation environment. As mentioned above – there are many innovation, research and educational organisations but the companies often do not know how to use their services or how to use some advanced financial models (venture capital, crowdfunding, etc.). Fully established digital innovation hub could take the role of a broker that connects various parts of the innovation chain and accelerates the growth of innovation in the region.

Structural macro-economic barriers

South Bohemian Region has a very low unemployment rate (2.01 %). On top of that, there is not enough of graduates and experienced personnel in the technical industries. This represents a large barrier for digitising since the companies cannot focus on innovation without it.

The region also suffers from selective migration – talented young people often study in Prague and Brno and then choose to stay in those cities. Partly because it has insufficient programmes to support talented students.

People working in the research and development often do not have an experience with management, marketing, B2B cooperation and technology transfer. Insufficient qualification of employees and their migration to other regions/countries are slowing down the development of companies and deter new companies from investing in the

region. The region is realising the fact and is addressing it in its new regional innovation strategy (increasing of quality and availability of human resources).

Sources of available public finance for innovation projects

There are many funding options for organisations based in the Southern Bohemian Region. They can apply for regional, national and European funding.

Programs from the European Structural and Investment Funds represent first option. The programs are managed either by European Regional Development Fund or by the European Social Fund. Organisations from the City of Prague can apply for one of the following programs:

- Operational Programme Research, Development and Education, allocation of this programme is 2.77bn EUR (for the whole Czech Republic)
- Operational Programme Employment, allocation of this programme is 2.15bn EUR (for the whole Czech Republic)
- Integrated Regional Operational Program, allocation of this programme is 4.64bn EUR (for the whole Czech Republic),

or managed by Cohesion Fund for the Czech Republic:

- Operational Programme Environment, allocation of this programme is 2.64bn EUR (for the whole Czech Republic)
- Operational Programme Transport, allocation of this programme is 4.70bn EUR (for the whole Czech Republic).

The key principle of the Operational Programme Research, Development and Education (OP RDE) is the development of human resources for the knowledge economy and sustainable development in socially cohesive society and it is supported by interventions in the context of several priority axes (PA). This is followed by the theme of support for quality research, for which the qualified workforce represents the key input factor.

The aim of the Operational Programme Employment (OPE) is to improve the human capital of the population and public administration in the Czech Republic, i.e. the basic elements of competitiveness.

Integrated Regional Operational Programme (IROP) follows the seven regional operational programmes and partly the Integrated Operational Programme of the 2007-2013 programming period. The priority of IROP is to enable a balanced territorial development, improvement of the infrastructure, improvement of public services and public administration and ensuring sustainable development in municipalities, cities and regions.

The main objective of the Operational Programme Environment (OPE) is to protect and ensure a quality living environment for the population of the Czech Republic, to support resource efficiency, eliminate negative impacts of human activities on the environment and to mitigate climate change impacts.

Through Operational Programme Transport 2014-2020 it is possible to finance infrastructure for rail transport, combined freight and urban public transport; then the road infrastructure owned by the state (motorways and main roads); and last but not least the public infrastructure for clean mobility (charger for electric vehicles and filling stations for alternative fuels), modernising rolling stock fleet and cargo vessels.

There are following funding options on the national level that exists thanks to National Initiative Industry 4.0:

- National innovation fund. It is intended to activate the venture capital market. It takes the form of reversible investment into young and innovative enterprises. Supported projects are usually in the proof of concept and prototyping stages in the high-tech fields with long ROI.
- Investment incentives law. It provides an opportunity for companies in the manufacturing industry, strategic services and technology centres to apply for lower taxes and support for creating new jobs and increase qualification of personnel.
- The trio, Gama and Epsilon. Ministry of Industry and Trade administer trio while Technology Agency of Czech Republic manages Gama and Epsilon. The goal of all three initiatives is to increase utilization of programs targeted to applied research and development

Regional funding is often related to the European and national programmes. One example is a Smart accelerator of South Bohemian Region. It is aimed toward boosting competitiveness and attractiveness of the region. Although this project is managed by the region, it is partly financed from EU using the Operational Programme Research, Development and Education.

Sources of private sector finance for innovation projects

Entrepreneurs from South Bohemian Region could apply for various incubation programs. Their goal is to help promising and innovative entrepreneurship ideas to find a way to become a profitable business. These programs can help to set up a new company within the legal framework of the Czech Republic, to develop a sustainable business plan or to identify a focus group for their product or service.

- Nastartujtese.cz is a grant program conducted by Komerční Banka and the Association of Small and Medium-Sized Enterprises and Crafts, which supports aspiring entrepreneurs. Nastartujtese.cz helps you to promote your project among potential clients and business partners and it gives the opportunity to receive financial support.
- Vodafone Foundation Laboratory (Laboratoř Nadace Vodafone) is an accelerator for NGOs and socially responsible businesses, which use technology to promote positive changes in a society and have the ambition to address thousands of users. The laboratory helps to find their optimal setting and to validate market interest to make the project financially sustainable. It is aimed for projects in their pre-seed and spin-off stage or those, which have low impact and need to be restarted.

There is also a business incubator located in South Bohemian Science and Technology Park (JVTP). Mission and purpose of JVTP is to support entrepreneurship in the region. JVTP offers an environment in a form of equipped laboratories, offices, seminar rooms or technology halls, and provides to enterprises that are set there all that they need for their activities.

Positive and negative examples of initiatives undertaken in the region

South Bohemian Region is home to many successful companies that used the support from JVTP. They range from IoT and software development to pharmaceutical companies.

- **Bluematic.** This company deals with building up and maintaining networks for the internet of things, and with producing devices for data gathering (chips). The main features of this network are long signal coverage of the base stations (to 40 km in open landscape, units of kilometres in a built-up area) and low energy demands of the devices. All network technologies applied by this company comes from their own development and production.
- **LARX.** LARX was founded for developing software for intelligent housing or home automation (managing various home technologies through a mobile application). The company develops an upgrade for mobile applications of this system in a direct cooperation with an Austrian company – the only owner of a license on the operating system LOXONE - for mobile managing of the intelligent houses.
- **NATURA IMUNECO.** It is a Czech company and its main activity is the production of the food supplement Vitestin® and research of its influence on inflammatory diseases of the digestive tract, especially on Crohn's disease, ulcerative colitis, but also on idiopathic bowel diseases. The company works closely with patients who were diagnosed with these diseases.

The biggest issue of the region is insufficient space designated for its innovation centres. South Bohemian Science and Technology Park located in Ceske Budejovice is experiencing a strong demand for its services but it cannot house more companies due to its capacities. Although it has secured funding for new building, it does not have a space to build it on.

2.2.5 Estonia

Estonia is located in north-eastern Europe and it is the northernmost of the Baltic states. The capital and the biggest city of Estonia is Tallinn with the population of 413 782. According to European Commission's Small Business Act (SBA) there were 68 855 SMEs in Estonia in 2017, which accounted for 99.8 % of the total of Estonia's enterprises (European Commission, 2017).

Estonia ranks 23rd out of 137 countries in the 2017 Global Entrepreneurship Index (Ács, Szerb, & Lloyd, 2018). The same study places Estonia in the 15th ranking in the European region, where the ranking is led by Switzerland, the United Kingdom and Denmark.

According to Statistics Estonia, in 2016 the exports of goods from Estonia at current prices totalled 12bn EUR and imports 13.6bn EUR. Estonia's major exports are machinery and equipment, wood (wood products), agricultural products and food preparations, miscellaneous manufactured articles and mineral products. Estonia's main imports are machinery and equipment, transport equipment, agricultural products and food preparations, mineral products, and chemical products. Imports from the EU28 countries to Estonia totalled 11.1bn EUR with the share of 82 % of Estonia's total imports in 2016.

Foreign investors are guaranteed a level playing field with local firms, including unrestricted repatriation of profits and capital along with the right to own land. Many costs such as energy, labour, transport services, telecommunications and property expenses are considerably lower than in other parts of the Baltic Sea region. Nevertheless, Estonia has acquired a well-deserved reputation for the high quality of its products. Covering a wide range of industries, investors find they can achieve Scandinavian quality levels at lower costs.

Today foreign companies dominate in several sectors of the Estonian economy. Banking and telecommunications are dominated by the Nordic players, but the food and electronics industries also rely heavily on foreign capital. In relation to its size, Estonia has long been a leading Eastern European country in attracting foreign direct investments. Estonia is one of the leaders in Central and Eastern Europe in terms of foreign direct investments (FDI) per capita. The stock of total FDI peaked at 18.4bn EUR as of 31 December 2016 48.3 % of foreign investment came from Sweden and Finland. (Estonian Ministry of Foreign Affairs, 2017)

Industrial production is an important segment of the Estonian economy. It is the largest sector in terms of providing jobs and it makes up the largest segment of the Estonian economy. Industrial production is growing steadily but has fallen behind of the European average in effectiveness and added value rates.

Estonia ranks 19th on Fraser Institute's "Economic Freedom of the World: 2016 Annual Report", economic freedom scoreboard. Of Estonia's neighbours and main trading partners, Lithuania ranks 15th, Finland 20th, Latvia 27th, Germany 30th and Sweden 38th. The World Economic Forum's Global Competitiveness Index 2016-2017 ranks Estonia 30th among 138 countries. The survey among business leaders measures economic competitiveness based on a combination of technology, the quality of public institutions, and the macroeconomic environment.

Estonia's open economy, excellent transportation links and central location make it an ideal base for production and distribution. Estonia has captured a considerable share of the rapidly growing transit trade through the Baltic Sea. The deep-water port and free zone of Muuga is one of the most advanced in the region. It serves as an entry point for the Baltic and CIS markets. The new multifunctional port and free zone in the north-east of Estonia, Sillamäe, is the easternmost port of the EU, capable of handling all cargo groups from oil products and dry bulk to containerised cargo. Passenger and freight links provide fast sea crossings across the Baltic Sea, while direct air connections give easy access to Tallinn from major European capitals. (Estonian Ministry of Foreign Affairs, 2017)

International analysts consider Estonia to be the leader in Eastern Europe for broadband DSL access. In terms of DSL penetration per telephone line, Estonia presently ranks among the top ten in the world.

In addition to physical Internet access points, there are over 1 006 free wireless Internet (Wi-Fi) zones around the country. In recent years the number of fixed phone lines has decreased as many consumers switched from fixed phones to mobile phones. All of Estonia is covered with digital mobile phone networks. There are more mobile phone contracts than residents - 139 per 100 people (Statistics Estonia, 2011).

Demand-side barriers regarding the implementation of digital transformation

Estonia ranks in ninth place in the EU in its progress towards a digital single market according to the latest Digital Economy and Society Index 2017 (European Commission, 2017). This ranking places Estonia in a high-performing cluster of EU nations, with Denmark, Sweden, Finland and the Netherlands occupying the top four spots in the ratings. However, Estonia's progress as a whole has slowed down in the recent years, in part due to poorer broadband and ultra-fast broadband coverage across the country, something partly compensated for by a wide mobile data coverage.

Another challenge facing Estonia on the technology front is the digitisation of companies in the private sector. Regarding the EU 28 as a whole, the DESI 2018 states that whilst the EU is undoubtedly getting more and more digitised, it is somewhat off the pace compared with global leaders, as well as suffering from an uneven distribution of progress and technological development across the region. (ERR, 2018)

Although Estonia still lags behind in the integration of digital technologies compared to the EU average, the country made progress over the last year. This is the dimension in which Estonia performs least well and ranks 19th (from 20th) in DESI 2018. Estonia is performing relatively better in e-commerce compared to eBusiness. In fact, the percentage of SMEs selling online is slightly above the EU average (15.4 % compared to 10.7 %). E-commerce proves to be a channel that can guarantee significant turnover (11.4 % of their turnover versus 10.3 % in the EU), including by looking for opportunities in markets abroad (8.3 % of SMEs are selling online cross-border). 17.1 % of the enterprises selling online to other EU countries reported that the high cost of delivery is the main trade barrier. On the other hand, 75.9 % of the enterprises reported no difficulties. The demand-side barrier is influenced by the fact that Estonia does not have a specific strategy in place for the digitisation of its economy. Emphasis is rather put on creating an enabling environment for digital innovation, including the necessary infrastructure and skills. (DESI 2018)

Structural macro-economic barriers

The unemployment rate of Estonia has been decreasing steadily and was 6.5 % in 2018. That is the lowest in all of the Baltic states and below EU's average. Steady low unemployment rates make up a troubled situation for employers in the industrial production sector as they struggle to find suitable employees. Furthermore, the average salary has been steadily increasing in Estonia, with the yearly growth rate adding up to 6.4 % (Statistics Estonia, 2018). The trend is predicted to continue, increasing the costs of production in Estonia.

The country shows a good performance in ICT start-ups. Regarding the specific ICT sector, companies do not report any difficulties in recruiting ICT specialists. However, enterprises in manufacturing sectors encounter problems in finding specialists such as experts in mechatronics or robotics. This might be a reason for the mixed performance in terms of Integration of Digital Technologies. (DESI 2018)

Sources of available public finance for innovation projects

There are various public sector financing sources available for innovation projects.

- Enterprise Estonia offers various grants for innovation projects. The maximum amount of the grant is dependent on the income of the company, up to 15 000 euros. The financing option is aimed at SMEs in order for them to perform diagnostics on digitalisation and automation.
- Enterprise Estonia also offers a development grant that is targeted at SMEs for research on developing innovative products, services or technologies. The grant is available in the maximum amount of 20 000 euros.
- Estonian Norwegian collaboration project Green ICT offers funding for innovative technological projects that create added value, decrease the waste of resources and develop international collaboration. The project offers funding in two

categories - first round of up to 20 000 euros per company and 2nd round of 200 000- 700 000 euros per company.

Sources of private sector finance for innovation projects

The private sector finance options for innovation projects are connected with loan provider Kredex offers an industrial loan that helps to finance companies in the field of industrial production who are looking to invest in material and immaterial capital (such as software or R&D).

Positive and negative examples of initiatives undertaken in the region

Estonian Association of Information Technology and Telecommunications, Federation of Estonian Engineering Industry and Hyrles OÜ collaborated on a project called Creation of a demo environment for industry digitalisation solutions. The aim of the project was to highlight that digitalisation of industrial production enables an increased effectiveness and productivity by decreasing labour costs and utilizing machines to an optimal capacity.

Estonian ICT Cluster initiated a project where companies from the ICT sector and representatives of the Tallinn University of Technology piloted a smart suit for workers and supervisors exposed to high risk in working environments called Ragnarok Workwear 2.0. The product features fall detection, monitors vital signs and activity, GPS positioning and tracking, safety light, speech to text and other features.

Estonian Ministry of Economic Affairs and Communications has created a Collaboration Hub for integrating the digitalisation of industries by 2030. The purpose of the initiative is to develop Estonia's competencies on various fields related to industrial production. The initiative aims at supporting export in a sustainable manner, making financial means available, developing necessary vocational studies, branding industrial production, employing digital technologies in the industry sector on a broad scale, recycling existing raw materials. The Collaboration hub prioritises composing a working group of the representatives of 10 of the most influential enterprises that would convene regularly and provide feedback on relevant issues. The Collaboration hub is a voluntary working group for the discussions around the industry digitalisation.

2.2.6 Hungary

2.2.6.1 West Transdanubia

West Transdanubia (WT) is a developed, industrialised region at Hungary's western border. It is the only region beside Central Hungary, where GDP per capita is above the national average (115.8 % in 2015); nevertheless it is only 30.5 % of the EU28 average (Eurostat). The region is less densely populated, with higher employment shares in manufacturing, and lower shares in services and public administration.

The region experienced rapid foreign direct investment (FDI)-driven growth after the change of the regime, and also currently the key driver of regional growth is the export-oriented production of foreign subsidiaries. Although the region's share in the total FDI stock diminished from 20.45 % in 2011 to 17.6 % by 2014, it still ranks second after Central Hungary with respect to FDI attraction potential. FDI reinforced the region's specialisation in mature manufacturing industries: automotive, electronics and machinery and equipment. WT's industrial production per capita is the highest in Hungary; it is 184 % of the national average (2016). The region

accounted for 23 % of Hungary's total industrial production in 2016. Manufacturing employment was 30.3 % of the total employment in 2014 (EURegion, 2015).

WT is the most specialised in automotive industry. Data on the performance of the automotive sector exist only for the national level: this industry has been the main engine of Hungary's economic growth for several years since the global crisis. In 2015, the value of total output of automotive industry was EUR 25.3m (data published by the Hungarian Investment Promotion Agency). The total employment in automotive industry was more than 149k. The industry accounted for 21.6 % of the total manufacturing export. Although WT's share in the total automotive production declined since the early 2010s, which is mainly due to greenfield investments in other regions, the region still features a high concentration of automotive industry. Consequently, the 2008-2010 crisis hit West Transdanubia particularly hard: the number of jobs decreased by nearly 7 % between 2007 and 2010. Since then, growth resumed and employment increased (unemployment is the lowest in the country - 2.7 % in 2016).

WT's manufacturing actors are deeply integrated in global value chains, either as local subsidiaries (export-oriented manufacturing facilities of multinational corporations (MNCs), whose sales channel is dominantly intra-firm) or foreign- or domestic-owned suppliers of the first group (of MNCs' export-oriented local subsidiaries). Suppliers operate in the machinery, electronics, plastic and metal processing and casting industries.

The easy accessibility of Hungary is often cited as one of its main advantages: it is at the crossroads of four main European transport corridors. Hungary has one of the highest motorway densities in Europe.

West Transdanubia's scientific research potential is aligned with its specialisation in advanced manufacturing. Key science centres (Széchenyi University, University of West Hungary) have benefitted from generous public support to build up research infrastructure comprising measuring and testing equipment that can be considered unique in Central Europe.

There are two science and technology parks in West Transdanubia:

- The industrial park of Győr is one of the region's success stories, dating back to the massive inflow of foreign investors in the 1990s and 2000s. There are currently about 100 manufacturing companies settled in the park, with altogether 6,000 employees and a total investment of EUR 533m. In line with its expansion, the park's management has developed and upgraded its services. One of the often-proclaimed current objectives of the park's management is to enhance the collaboration of the companies within the industrial park.
- Another example of a successful science and technology centre is INNONET, established in 1997. INNONET is a technological competence centre that provides technology services (e.g. rapid prototyping), and management and business incubation services to the region's SMEs.

The region also hosts innovation-driving institutions and facilities:

- Example of a successful cluster is Professio Metalworking Cluster. Its members include companies specialised in metal processing and casting, manufacturing of customised industrial equipment and industrial automation solutions. Cluster members are suppliers of some of the surveyed flagship companies in the region, and obviously of other companies (mainly MNCs in Hungary and abroad).

Besides information sharing and networking, the main purpose of cluster members' collaboration is to enhance the quality of dual education in the region, to raise awareness of the importance of up-to-date vocational training and engineering education.

- Pannon Business Network Association is leading NGO in the region.
- Pananerg Cluster popularise renewable energy.
- Vas County Scientific Educational Association spread professional and knowledge for intellectuals.
- Pannon Thermal Cluster promote new thermal medicinal and tourism relations.
- Pannon Textil Cluster promote the clothing industry.
- Pannon R&D in engineering foster the R&D activity especially in engineering in Vas and Zala county (West Transdanubia) with particular regard to the cooperation of SMEs.
- The ELTE Gothard Astrophysical Observatory (GAO), located in Szombathely, has been the most determining academic centre in the county for decades. The aim of the observatory is to become one of the most significant centres of the research based on Big Data, and the ESA and NASA space research in Europe.

In order to building bridges between the physical and digital worlds the Industry 4.0 National Technology Platform was established under the leadership of the Institute for Computer Science and Control (SZTAKI), Hungarian Academy of Sciences, with the participation of research institutions, companies, universities and professional organisations having premises in Hungary, and with the full support and commitment of the Government of Hungary, and specifically that of the Ministry of National Economy. The platform is aim to deepening the existing successful partnership relationships as well as adopting the European best practices, especially the implementation of the German patterns.

Europe's Digital Progress Report (EDPR) tracks the progress made by Member States in terms of their digitisation, combining quantitative evidence from the Digital Economy and Society Index (DESI) with qualitative information on country-specific policies. Hungary ranks 21st out of the 28 EU Member States. Overall, it progressed at an average pace over the last few years. Hungary performs well on Connectivity, thanks to the wide availability of fast fixed broadband (NGA) and 4G as well as to the increasing broadband take-up on fixed networks. Mobile broadband take-up is, however, not yet accelerating. Hungary improved in digital skills, but stands still slightly below the average. More Hungarian businesses use social media, eInvoices, cloud and eCommerce. Nevertheless, the business sector is not exploiting the opportunities offered by digital technology as much as other countries do, pushing Hungary back in the ranking. As for eGovernment, despite minor improvements in the online provision of public services, Hungary ranks 27th, scoring below the EU average in all aspects.

On the Integration of Digital Technology by businesses, Hungary's ranks 24th on DESI, well below the EU average, although it managed to improve and advance three ranks compared with last year. Hungary progressed in all indicators. 13 % of enterprises use social media (up from 11 % in 2015), 8 % send eInvoices (6 % in 2015), 8 % use cloud services (6 % in 2015) and 12 % of SMEs sell online (10 % in 2015). However, on all of the above indicators, Hungary performs well below EU

average, meaning that the business sector cannot fully exploit the opportunities offered by digital technologies.

Regional Innovation Scoreboard 2017 shows Hungary as a Moderate Innovator country. Hungary includes one NUTS 1 and six NUTS 2 regions. West Transdanubia is a Moderate – Innovator. Its performance has decreased with almost -10 %.

The government has launched two programs to reach about 7000-8000 SME's in cohesion regions and encourage them to develop a more advanced use of ICTs. The Modern Businesses Program focuses on awareness raising, while the Support of business digital developments project will provide grants and loan financing to carry out investment in ICT developments. These may include for example the development of Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) solutions, web shops as well as mobile and advanced cloud solutions. There are several governmental programs in Hungary to support the digital start-ups. The program EDIOP13 3.1.3 aims at establishing expert and mentor networks to facilitate ICT start-up companies' entry to international markets through the provision of free consultancy, training, and events. This project targets 300 digital start-ups. EDIOP 8.2.3, to be launched in the first half of 2017 will complement the above program by providing venture capital financing to ICT start-ups. In the meantime, the Ministry for National Development has recently started the preparation of a Hungarian Industry 4.0 strategy. Once this strategy is adopted, the government will define and start new measures and programs for the digitisation of the industry during 2017. The European Structural and Investment Funds (ESIF) play a key role in financing all of the above programs.

Hungary well recognised the need to strengthen digital entrepreneurship and the use of ICTs by business. The recently launched programs and those in the pipeline are rightly targeting both the ICT sector and the use of ICTs in other sectors of the economy.

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. Hungarian RIS are:

- **Healthy society and wellbeing:** understanding diseases, early diagnosis, advanced medical and instrumental therapies, clinical methods, pharmaceutical research and development, innovative health industry and health. tourism solutions
- **Advanced technologies in the vehicle and other machine industries:** machine industry RDI, advanced production technology systems, advanced materials and technologies (technical materials science, materials technology, nanotechnology, mechatronics and electronics)
- **Clean and renewable energies:** green energy – renewables and bio-energy, nuclear energy, energy efficiency
- **Sustainable environment:** natural resource management, advanced environmental technologies
- **Healthy local food:** food processing, locally produced and processed food of high added value
- **Agricultural innovation:** agriculture, forestry, hunting, aquaculture and water management, horticultural technologies, agricultural biotechnology

Demand-side barriers regarding the implementation of digital transformation

The European Innovation Scoreboard 2017 shows relative weaknesses in the following areas:

- **Innovators:** Most SMEs have shortcomings in their management and the level of innovation. The main issues are the low level of innovativeness, the talented people are attracted by central (Budapest) region, and lack of international scientific co-publications, perhaps because of the limited foreign language skills.
- **Finance and support:** The level of institutional R&D funding is low and less tied to performance. The SME sector is underfunded, and the innovation and growth ambitions and abilities are weak in a global comparison.
- **Intellectual assets:** The demand for the protection of industrial property rights is extremely weak.

The remaining challenges in terms of upgrading based on the West Transdanubia's existing specialisation and endowments are as follows:

- **Reduce disparities in adopting Industry 4.0 solutions:** Although the largest intra-regional gap is between technology adopters and nonadopters, there are substantial differences also across adopters. Despite a relatively good average performance with respect to the diffusion of Industry 4.0 technologies, there are large intra-regional, and size- and ownership-related differences in this respect.
- **Improve the return on investments from universities' up-to-date research infrastructure:** Although the establishment of new laboratories has enhanced industry–university collaboration, and it has had beneficial impact on practice-based higher education, while ensuring non-negligible income to universities, the return on investments from this research infrastructure shows large disparities across universities and equipment items. A systematic business model needs to be elaborated by each university to ensure fair return on public investment in research infrastructure.
- **Increase the number of available qualified employees through expanding and upgrading higher education:** Executives were unanimous in claiming that the most important barrier of their local expansion and upgrading is the lack of qualified employees. Although no negligible improvement has been achieved in West Transdanubia in this respect, demand for skills has been growing at an even higher pace. In the 'second machine age', despite all upgrading, higher education in West Transdanubia (and in Hungary) seems to fall behind in 'the race between education and technology'.

In order to implement and develop digital transformation in the West Transdanubia Region, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for added-value creation and servitisation, attracting external and foreign funding to leverage investment risks.

The above is set as a business goal of three Hubs in Hungary, one of them operates in the West Transdanubia Region (AMLab), which takes part in the Smart Factories in the new EU Member States project.

Structural macro-economic barriers

One of the structural problems in Hungary is its low level of enterprises' digitalisation. After excluding high-tech companies, most of the Hungarian SMEs seem to be unaware of possibilities offered by digitalisation.

One of the major issues with regard to the future development of the region in general, and of regional advanced manufacturing, in particular, is the poor availability of knowledge and skills related to advanced manufacturing. In industrial environment that combines physical and virtual reality, there is an increasingly pressing shortage of both workforce with general operational skills and of engineers with up-to-date engineering knowledge. There is a huge battle for fundamental resources - skilled professionals - in the digital economy. The government aims to constantly broaden the variety of digitally competent workforce with a thoroughly-designed development framework which strives to develop basic digital competencies and to restructure professional IT education.

In Hungary there are relatively few small and medium-sized enterprises suitable for growth and exports. The Irinyi Plan points out three main barriers what could cause this condition:

- The lack of willingness to become an entrepreneur, and of the basic skills required for business practices are the main impediments to the development of a productive and competitive SME sector, and therefore it is one of the focus points of the Government's activities
- The other major inadequacy is the shortage of capital of SMEs and the consequential obsolete business infrastructure, which may be eliminated through capacity extension
- The third area is a low level of willingness to co-operate and efficiency, which we intend to remedy by developing networks within the economy.

Concerns remain regarding the prevention and prosecution of corruption. According to several indicators, Hungary's exposure to corruption appears to have increased over the past years and the risks of corruption could negatively affect the country's growth potential. The government favours national and government-linked companies in certain industries.

Sources of available public finance for innovation projects

Quantum Leap as a Győr-based incubator launches competition for start-ups in connection to the grant contract with the identification number GINOP-2.1.5-15-2016-00011. Within this project a maximum of 60M Forint non-refundable incubation fund can be won by start-up for which -according to GINOP ruling- a 20 % contribution is necessary. The incubator provides the enterprises with a private equity investment in the amount of at least 20 % of the sums awarded that with the maximum of 24 % equity participation in the start-up company.

A wide range of tender calls are available from EU Funds. The tenders reflect the importance of supporting several aims (e.g. R&D activities, creation of new workplaces, environmental investments etc.) and the focus on small- and medium-sized enterprises. The conditions for the EU tender application, the timing, and the total amount of the subsidy available vary from tender to tender.

The maximum regional aid intensity in Hungary varies between 20 % and 50 %, except in Budapest and several towns of Central Hungary where no regional aid can be granted.

- For a manufacturing asset investment the minimum criteria are: 5-20M EUR and 50-100 new jobs, depending on the location. Further conditions may apply (e.g. for Pest county). The aid intensity is according to the regional aid map.
- In the case of job creation the minimum criteria is 10M EUR and 50-100 new jobs depending on the location. The aid intensity is according to the regional aid map.
- There is also an opportunity for technology intensive investments of a minimum of 30M EUR without specific new job criteria. The aid intensity is a maximum of 25 percent of the regional aid intensity.
- In the case of establishing or expanding SSCs, at least 50 new jobs have to be created without investment amount criteria. The aid intensity is according to the regional aid map.

Non-regional aid from Hungarian Funds:

Subsidy can be obtained – based on individual Government decisions – for R&D projects that last a minimum of one and a maximum of three years, with a minimum of 3M EUR in eligible costs. The aid intensity is up to 25 % of the eligible costs, and the maximum available subsidy is 15M EUR. At least 25 new R&D-related jobs have to be created (50 % of the new jobs created have to be employees with higher education). “VIP” training subsidy is offered for the training of a company’s own employees. The subsidy is available to investors creating at least 50 new jobs in Hungary. Aid intensity is a maximum of 50 % of the eligible costs. The subsidy amount is limited by the total number of training participants (varies between 0.5-2M EUR subsidy per project) and by a maximum average limit per participant (EUR 3,000 subsidy per participant).

To join the INPUT Program is also available, what aims to facilitate the transformation and growth of the Hungarian start-up ecosystem by helping brave individuals to build new and sustainable ventures and by supporting already existing enterprises.

Sources of private sector finance for innovation projects

The types of incubation activities of Győr based Quantum Leap Ltd. are teaching semesters (e.g. for the EIT Climate-KIC), individual mentoring (eg. Valley Connect program), training, coaching, workshops (e.g. Start-up Campus program) and personal consulting support, or coaching.

Currently, entrepreneurs in Hungary have a few options for funding. Day One Capital, for example, is an early-stage investor that manages privately financed funds to invest in countries within the CEE. Other active venture funds include Quantum Leap, Baconsult, Digital Factory, A3 Ventures and Buran Venture Capital. Moreover, leaders of local success stories have begun investing and taking more active roles within the ecosystem.

This year specifically has seen a number of developments with regard to venture funding in Hungary. As an auxiliary component of its successful accelerator OXO Labs, former Finance Minister Peter Oszko launched OXO Ventures and announced a new 50M EUR fund in partnership with the European Investment Fund to focus specifically on innovative early-stage tech companies. Additionally, Hiventures has been actively investing from its 160M EUR fund, sponsored by the European Union and the Hungary

Development Bank. While traditional investors place their bets on new technology, Hiventures focuses more on building innovation.

Positive example of initiative undertaken in the region

A prominent example of good practice is the iKomp project 'Strengthening the regional research competencies related to future-oriented manufacturing technologies and products of strategic industries by a research and development programme carried out in comprehensive collaboration. The project encompasses nine regional stakeholders: two universities (Széchenyi University and the University of West Hungary), a research institution of the Hungarian Academy of Sciences (SZTAKI), and six companies, including local subsidiaries of large blue chip global companies, subsidiaries of relatively smaller multinational corporations and Hungarian-owned companies.

The origin of the iKomp consortium can be traced back to a decade-long networking activity among a large number of stakeholders in the region of Zalaegerszeg (the capital of Zala county). The network comprises representatives of manufacturing firms: SMEs, large Hungarian-owned companies, subsidiaries of multinational corporations, innovation management and consultancy firms, NGOs, industry associations, a public foundation (for the tertiary education in Zalaegerszeg), universities and public research institutes. The mission of this network is to contribute to the innovation-oriented development of the region, and enhance industry-university collaboration. It must be noted that the boundaries of the region are loosely defined: the network comprises stakeholders also in Szombathely and Szentgotthárd, both in the neighbouring Vas county. The project closed last year. The project members (more than 25 organisations) carried out 232 research and development projects.

2.2.6.2 Southern Great Plain

Southern Great Plain region is less densely populated, with higher employment share in agriculture, and lower than average GDP per capita, but higher GDP per capita growth compare to the national average. The region is one of the less developed region: it generated 9.3 % of Hungary's GDP in 2015. GDP per capita amounted to EUR 7,429.63 in 2015, and was 19.7 % of EU28 average. The unemployment rate is slightly above the national average 5.6 % (5.08 % the Hungarian average).

Located in South Hungary the University of Szeged (SZTE) is a leading workshop of education, science, research, innovation and it has an outstanding role in the region's cultural, social life and economic activities. SZTE is one of the most popular university of Hungary and it is highly ranked internationally with its 2200 academic research and teaching staff and its 21.000 student body. It has been considered as one of the world's best 500 universities for years and it is known as a green institution. It offers broad range of educational opportunities to national and international students. Research, Development and Innovation activities of the institution are acknowledged internationally and the University is in partnership with numerous industrial partners and companies such as the ELI-ALPS Laser Research Centre, one of the largest scientific investments in Europe. On top of these SZTE has contracted with 497 Erasmus+ partner universities in 30 countries and has 927 cooperation agreements. Scholarships, such as the Stipendium Hungaricum Scholarship Programme assist students from various regions of the world.

There is one science and technology park in Southern Great Plain:

- The KÉSZ Industrial Park, as a construction logistic centre provides excellent opportunities for the construction industry and its auxiliary services. During operating the Industrial Park they seek to create such effective and economical real estate combination that helps to develop a long-range business partnership with their existing and future partners. The KÉSZ Ltd., one of the biggest construction companies in Hungary, counts on different companies involved in construction, trade, warehouse, transport etc., and at the same time on services such as banks, insurance, legal offices, all connected to the basic activity. Of course, any other project can be established in this free area.

The KÉSZ Industrial Park provides services for construction engineering, the relating research and development, different architectural, electro technical, and vehicle production, the full scope of logistic. The wider range of services includes the design, dealing with the project, material economisation (from storage till delivery), construction, trade and maintenance. As an innovation centre, the KÉSZ Industrial Park provides the infrastructure for the economic, scientific and technical development, operational expert's support for the companies, modern information system, and high-level background for services. The Industrial Park is equipped with excellent telecommunications network (ISDN Primary) and public utilities. The KÉSZ Industrial Park has own gas engine power plants that supply electric power at a low price.

The region hosts innovation-driving institutions and facilities.

- Kecskemét – with more than 11 thousand active companies – has an important function in the Southern Great Plain region. Since June 2017 in every quarter Tech Meetup take place in Kecskemét. The events main supporters are the INPUT Program, IQ Kecskemét (company for innovation, part of the KÉSZ Holding) and Anserminer (start-up company in a field of data science)
- Szeged is the third largest city of Hungary, the largest city and regional centre of the Southern Great Plain where are available coworking places like Jumpstart or Kapca Coworking Office.

In order to building bridges between the physical and digital worlds the Industry 4.0 National Technology Platform was established under the leadership of the Institute for Computer Science and Control (SZTAKI), Hungarian Academy of Sciences, with the participation of research institutions, companies, universities and professional organisations having premises in Hungary, and with the full support and commitment of the Government of Hungary, and specifically that of the Ministry of National Economy. The platform is aim to deepening the existing successful partnership relationships as well as adopting the European best practices, especially the implementation of the German patterns.

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Hungary back in the ranking. As for eGovernment, despite minor improvements in the online provision of public services, Hungary ranks 27th, scoring below the EU average in all aspects.

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Regional Innovation Scoreboard 2017 shows Hungary as a Moderate Innovator country. Hungary includes one NUTS 1 and six NUTS 2 regions. Central Hungary, the capital region, is the most innovative region and the only Moderate + Innovator. Two regions, include Southern Great Plain are Moderate Innovators and four regions are Moderate - Innovators. Performance has increased for two regions and most strongly for Southern Great Plain.

The government has launched two programs to reach about 7000-8000 SME's in cohesion regions and encourage them to develop a more advanced use of ICTs. The Modern Businesses Program focuses on awareness raising, while the Support of business digital developments project will provide grants and loan financing to carry out investment in ICT developments. These may include for example the development of Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) solutions, web shops as well as mobile and advanced cloud solutions. There are several governmental programs in Hungary to support the digital start-ups. The program EDIOP13 3.1.3 aims at establishing expert and mentor networks to facilitate ICT start-up companies' entry to international markets through the provision of free consultancy, training, and events. This project targets 300 digital start-ups. EDIOP 8.2.3, to be launched in the first half of 2017 will complement the above program by providing venture capital financing to ICT start-ups. In the meantime, the Ministry for National Development has recently started the preparation of a Hungarian Industry 4.0 strategy. Once this strategy is adopted, the government will define and start new measures and programs for the digitisation of the industry during 2017. The European Structural and Investment Funds (ESIF) play a key role in financing all of the above programs.

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Demand-side barriers regarding the implementation of digital transformation

The European Innovation Scoreboard 2017 shows relative weaknesses in the following areas:

- **Innovators:** Most SMEs have shortcomings in their management and the level of innovation as well as marketing and organisational innovations
- **Finance and support:** The level of institutional R&D funding is low and less tied to performance. The SME sector is underfunded, and the innovation and growth ambitions and abilities are weak in a global comparison
- **Intellectual assets:** The demand for the protection of industrial property rights is extremely weak.

In order to implement and develop digital transformation in the Southern Great Plain Region, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for added-value creation and servitisation, attracting external and foreign funding to leverage investment risks.

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Structural macro-economic barriers

One of the structural problems in Hungary is its low level of enterprises' digitalisation. After excluding high-tech companies, most of the Hungarian SMEs seem to be unaware of possibilities offered by digitalisation.

In Hungary there are relatively few small and medium-sized enterprises suitable for growth and exports. The Irinyi Plan points out three main barriers what could cause this condition:

- The lack of willingness to become an entrepreneur, and of the basic skills required for business practices are the main impediments to the development of a productive and competitive SME sector, and therefore it is one of the focus points of the Government's activities

- The other major inadequacy is the shortage of capital of SMEs and the consequential obsolete business infrastructure, which may be eliminated through capacity extension
- The third area is a low level of willingness to co-operate and efficiency, which we intend to remedy by developing networks within the economy.

There is a huge battle for fundamental resources - skilled professionals - in the digital economy. The government aims to constantly broaden the variety of digitally competent workforce with a thoroughly-designed development framework which strives to develop basic digital competencies and to restructure professional IT education.

Concerns remain regarding the prevention and prosecution of corruption. According to several indicators, Hungary's exposure to corruption appears to have increased over the past years and the risks of corruption could negatively affect the country's growth potential. The government favours national and government-linked companies in certain industries.

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The maximum regional aid intensity in Hungary varies between 20 % and 50 %, except in Budapest and several towns of Central Hungary where no regional aid can be granted.

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2M EUR subsidy per project) and by a maximum average limit per participant (EUR 3,000 subsidy per participant).

To join the INPUT Program is also available, what aims to facilitate the transformation and growth of the Hungarian startup ecosystem by helping brave individuals to build new and sustainable ventures and by supporting already existing enterprises.

Sources of private sector finance for innovation projects

Creative Accelerator provides full-scale acceleration services with major focus on Life Sciences.

Currently, entrepreneurs in Hungary have a few options for funding. Day One Capital, for example, is an early-stage investor that manages privately financed funds to invest in countries within the CEE. Other active venture funds include Creative Accelerator, Baconsult, Digital Factory, A3 Ventures and Buran Venture Capital. Moreover, leaders of local success stories have begun investing and taking more active roles within the ecosystem.

This year specifically has seen a number of developments with regard to venture funding in Hungary. As an auxiliary component of its successful accelerator OXO Labs, former Finance Minister Peter Oszko launched OXO Ventures and announced a new 50M EUR fund in partnership with the European Investment Fund to focus specifically on innovative early-stage tech companies. Additionally, Hiventures has been actively investing from its 160M EUR fund, sponsored by the European Union and the Hungary Development Bank. While traditional investors place their bets on new technology, Hiventures focuses more on building innovation.

Positive example of initiative undertaken in the region

An EU-funded project set out to identify solutions to the increasing demand for buses on the streets of Budapest while keeping costs down and production local to Hungary. In response, the Modulo was conceived — a bus made of modular parts which is lighter, uses less fuel and is cheaper to produce than conventional buses. The project itself has already created jobs for 12 people. As over half of suppliers of the Modulo's parts are Hungarian SMEs, this should lead to growth in the bus production industry. The comfortable, clean and cost-effective Modulo bus represents a breakthrough not only in terms of fewer polluting emissions and a more sustainable and cost-effective transport system in Budapest, but also in kick-starting clean vehicle production across the country. This, in turn, should lead to higher demand and a wider take-up of electric and hybrid vehicles in Hungary. Total investment for the project "Development of electric, composite buses – Evopro Kft" is 2 619 767 EUR, with the EU's European Regional Development Fund contributing 1 307 449 EUR through the "South Great Plain" Operational Programme for the 2007-2013 programming period.

2.2.6.3 Central Hungary

Central Hungary – encompassing Budapest and Pest county – is the economic, commercial, financial, administrative and cultural centre of Hungary. Central Hungary is the most developed region: it generated 38.1 % of Hungary's GDP in 2015. Practically all its economic, social, institutional, educational and R&D-related performance indicators are above the national average. GDP per capita amounted to 30,334 EUR in 2015, and was 80.2 % of EU28 average.

Recent developments in economic performance have been ambiguous. The region's clear leadership has not only remained unchallenged, but the extraordinary development gap between Central Hungary and less developed regions has even

increased in the past decade. Hungary features one of the largest inter-regional dispersion in terms of GDP per capita. However, indicators of urban development and quality of life are mediocre compared to several other European capital regions of similar development level – because of a longstanding lack of systematic regional development strategy design and implementation.

The easy accessibility of Hungary is often cited as one of its main advantages: it is at the crossroads of four main European transport corridors. Hungary has one of the highest motorway densities in Europe.

The main drivers of regional performance are high-value knowledge intensive services. The biggest challenge jeopardising both regional economic performance and the shift to innovation-driven growth is the unfavourable turn in Hungary's fiscal and regulatory environment. In line with its central role, and its status as an economic, educational and innovation hub, innovation performance indicators are also outstanding in Central Hungary – compared to the national average –, which reflects a high concentration of research capacities in the capital. Innovation performance – even in the case of this outstanding region within Hungary – is meagre in comparison to the international average. International benchmark categorisations point to nonnegligible gaps between Central Hungary and advanced knowledge hub regions in terms of a wide variety of indicators. Regional R&D expenditure was far above the national average in 2015 (2.88 versus 1.16 %) and ~40 % above the EU28 average of 2.04 %.

Central Hungary is host to three out of the top 10 Universities in Hungary. The most well-known university is the [Budapest University of Technology and Economics \(BME\)](#) which specialises in areas such as technology, math, and physics. There is also [Corvinus University of Budapest](#) which is best known for its studies of business and economics, and [Central European University \(CEU\)](#) with strong MBA programs and even an accelerator that recently won the title as the [Best Accelerator and Incubator in Hungary](#).

While there has been a shift to place stronger focus on business education, however, most universities have accomplished this by partnering with large corporations that could guarantee jobs and high wages. Over the last two years, the country's most innovative educational strides have been taken in private developer and user experience schools sponsored by these larger corporations, in addition to an increasing number of coding bootcamps such as [Le Wagon](#), [Green Fox Academy](#), and [Codecool](#).

There are four science and technology parks in Central Hungary:

- INNOTECH Ltd. can be considered a traditional innovation park, since it provides the usual park services to its partners within its premises. It functions as a typical technology transfer company, since its main activity is the exploitation of the R&D results obtained at the Budapest University of Technology and Economics. INNOTECH markets the R&D capacities of the university researchers, thus they do not have to found new companies for their business activities, but they can use INNOTECH Ltd. as their own company. INNOTECH can exploit its experiences obtained in the field of regional development and SME support by providing services in these fields.
- Infopark Budapest is an innovation centre primarily for IT, telecommunication and software development companies where such multinational companies as Lufthansa Systems, Hungarian Telekom, IT-Services Hungary as well as young

innovative companies found a place for their head office. The seat of the European Institute for Innovation and Technology (EIT) is found in the Infopark as well. The office park has nearly 100,000 m² space to rent, offering high quality office and working environment for about 7,000 employees.

- Microsoft and several smaller companies, SAP's international research division chose Graphisoft Park as its Hungarian headquarters. The first biotech companies also arrived (Comgenex), and in 2007, the newest research lab was built for Servier, the French pharmaceutical firm. At present, about 80 companies operate in Graphisoft Park, with more than 4000 employees and 1000 students. The professionals who operate Graphisoft Park, in addition to developing high-quality, custom-made business environments, possess specialised expertise in designing biotechnological laboratories.
- Impact Hub has evolved into a rapidly expanding, diverse global network of over 16 000+ members in 100+ locations. Each community is a wealth of innovative programs, events, and cutting-edge content. Part innovation lab, part business incubator, and part community centre, they offer a unique ecosystem of resources, inspiration and collaboration opportunities to grow impact.

The region also hosts over a dozen innovation-driving institutions and facilities. Given the limited success of the government run projects, entrepreneurs have been turning to the growing number of other private incubators, accelerators, innovation labs, and coworking spaces.

- Design Terminal — one of the country's oldest and most well-recognised incubation systems — used to be fully run by government money, but now works from private money with some governmental partnerships. Another older incubator is Kitchen Budapest, which is run by Telekom Hungary. Newer start-up support organisations such as Telenor Accelerate, Lab.Coop, and Impact Hub Budapest, along with innovation labs like xLaboratories and Sparklab have begun making a positive impact on the start-up community as well.
- Coworking spaces too have sprung up where entrepreneurs can flesh out their ideas through close collaboration. Some that have garnered the most attention and proven themselves as the most important community meeting points include Mosaik, Loffice Budapest, Kaptár, and Impact Hub Budapest. Mosaik in particular, though founded just two years ago, has been fundamental in cultivating the expanding start-up ecosystem. In its first year, it hosted 152 high quality events focused on start-ups, innovation technology, and networking. Last year, it hosted more than one event per day.

In order to building bridges between the physical and digital worlds the Industry 4.0 National Technology Platform was established under the leadership of the Institute for Computer Science and Control (SZTAKI), Hungarian Academy of Sciences, with the participation of research institutions, companies, universities and professional organisations having premises in Hungary, and with the full support and commitment of the Government of Hungary, and specifically that of the Ministry of National Economy. The platform is aim to deepening the existing successful partnership relationships as well as adopting the European best practices, especially the implementation of the German patterns.

Europe's Digital Progress Report (EDPR) tracks the progress made by Member States in terms of their digitisation, combining quantitative evidence from the Digital Economy and Society Index (DESI) with qualitative information on country-specific

policies. Hungary ranks 21st out of the 28 EU Member States. Overall, it progressed at an average pace over the last few years. Hungary performs well on Connectivity, thanks to the wide availability of fast fixed broadband (NGA) and 4G as well as to the increasing broadband take-up on fixed networks. Mobile broadband take-up is, however, not yet accelerating. Hungary improved in digital skills, but stands still slightly below the average. More Hungarian businesses use social media, eInvoices, cloud and eCommerce. Nevertheless, the business sector is not exploiting the opportunities offered by digital technology as much as other countries do, pushing Hungary back in the ranking. As for eGovernment, despite minor improvements in the online provision of public services, Hungary ranks 27th, scoring below the EU average in all aspects.

On the Integration of Digital Technology by businesses, Hungary's ranks 24th on DESI, well below the EU average, although it managed to improve and advance three ranks compared with last year. Hungary progressed in all indicators. 13 % of enterprises use social media (up from 11 % in 2015), 8 % send eInvoices (6 % in 2015), 8 % use cloud services (6 % in 2015) and 12 % of SMEs sell online (10 % in 2015). However, on all of the above indicators, Hungary performs well below EU average, meaning that the business sector cannot fully exploit the opportunities offered by digital technologies.

Regional Innovation Scoreboard 2017 shows Hungary as a Moderate Innovator country. Hungary includes one NUTS 1 and six NUTS 2 regions. Central Hungary is the most innovative region and the only Moderate + Innovator. Two regions are Moderate Innovators and four regions are Moderate - Innovators.

The government has launched two programs to reach about 7000-8000 SME's in cohesion regions and encourage them to develop a more advanced use of ICTs. The Modern Businesses Program focuses on awareness raising, while the Support of business digital developments project will provide grants and loan financing to carry out investment in ICT developments. These may include for example the development of Enterprise Resource Planning (ERP) systems, Customer Relationship Management (CRM) solutions, web shops as well as mobile and advanced cloud solutions. There are several governmental programs in Hungary to support the digital start-ups. The program EDIOP13 3.1.3 aims at establishing expert and mentor networks to facilitate ICT start-up companies' entry to international markets through the provision of free consultancy, training, and events. This project targets 300 digital start-ups. EDIOP 8.2.3, to be launched in the first half of 2017 will complement the above program by providing venture capital financing to ICT start-ups. In the meantime, the Ministry for National Development has recently started the preparation of a Hungarian Industry 4.0 strategy. Once this strategy is adopted, the government will define and start new measures and programs for the digitisation of the industry during 2017. The European Structural and Investment Funds (ESIF) play a key role in financing all of the above programs.

Hungary well recognised the need to strengthen digital entrepreneurship and the use of ICTs by business. The recently launched programs and those in the pipeline are rightly targeting both the ICT sector and the use of ICTs in other sectors of the economy.

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. Hungarian RIS are:

- **Healthy society and wellbeing:** understanding diseases, early diagnosis, advanced medical and instrumental therapies, clinical methods, pharmaceutical research and development, innovative health industry and health. tourism solutions
- **Advanced technologies in the vehicle and other machine industries:** machine industry RDI, advanced production technology systems, advanced materials and technologies (technical materials science, materials technology, nanotechnology, mechatronics and electronics)
- **Clean and renewable energies:** green energy – renewables and bio-energy, nuclear energy, energy efficiency
- **Sustainable environment:** natural resource management, advanced environmental technologies
- **Healthy local food:** food processing, locally produced and processed food of high added value
- **Agricultural innovation:** agriculture, forestry, hunting, aquaculture and water management, horticultural technologies, agricultural biotechnology

Demand-side barriers regarding the implementation of digital transformation

The European Innovation Scoreboard 2017 shows relative weaknesses in the following areas:

- **Innovators:** Most SMEs have shortcomings in their management and the level of innovation.
- **Finance and support:** The level of institutional R&D funding is low and less tied to performance. The SME sector is underfunded, and the innovation and growth ambitions and abilities are weak in a global comparison.
- **Intellectual assets:** The demand for the protection of industrial property rights is extremely weak.

In order to implement and develop digital transformation in the Central Hungarian Region, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for added-value creation and servitisation, attracting external and foreign funding to leverage investment risks.

The above is set as a business goal of three Hubs in Hungary, one of them operates in the Central Hungarian Region (Innomine Group Ltd.), which takes part in the Smart Factories in the new EU Member States project.

Structural macro-economic barriers

One of the structural problems in Hungary is its low level of enterprises' digitalisation. After excluding high-tech companies, most of the Hungarian SMEs seem to be unaware of possibilities offered by digitalisation.

In Hungary there are relatively few small and medium-sized enterprises suitable for growth and exports. The Irinyi Plan points out three main barriers what could cause this condition:

- The lack of willingness to become an entrepreneur, and of the basic skills required for business practices are the main impediments to the development of a productive and competitive SME sector, and therefore it is one of the focus points of the Government's activities
- The other major inadequacy is the shortage of capital of SMEs and the consequential obsolete business infrastructure, which may be eliminated through capacity extension
- The third area is a low level of willingness to co-operate and efficiency, which we intend to remedy by developing networks within the economy.

Many employers struggle to find employees suiting their needs, which results in rising wages in the region. Central Hungary has a low unemployment rate (3.75 %), more than one percentage point lower than national unemployment rate in Hungary. There is a huge battle for fundamental resources - skilled professionals - in the digital economy. The government aims to constantly broaden the variety of digitally competent workforce with a thoroughly-designed development framework which strives to develop basic digital competencies and to restructure professional IT education.

Concerns remain regarding the prevention and prosecution of corruption. According to several indicators, Hungary's exposure to corruption appears to have increased over the past years and the risks of corruption could negatively affect the country's growth potential. The government favors national and government-linked companies in certain industries.

Sources of available public finance for innovation projects

A wide range of tender calls are available from EU Funds. The tenders reflect the importance of supporting several aims (e.g. R&D activities, creation of new workplaces, environmental investments etc.) and the focus on small- and medium-sized enterprises. The conditions for the EU tender application, the timing, and the total amount of the subsidy available vary from tender to tender.

The maximum regional aid intensity in Hungary varies between 20 % and 50 %, except in Budapest and several towns of Central Hungary where no regional aid can be granted.

- For a manufacturing asset investment the minimum criteria are: 5-20M EUR and 50-100 new jobs, depending on the location. Further conditions may apply (e.g. for Pest county). The aid intensity is according to the regional aid map.
- In the case of job creation the minimum criteria is 10M EUR and 50-100 new jobs depending on the location. The aid intensity is according to the regional aid map.
- There is also an opportunity for technology intensive investments of a minimum of 30M EUR without specific new job criteria. The aid intensity is a maximum of 25 percent of the regional aid intensity.
- In the case of establishing or expanding SSCs, at least 50 new jobs have to be created without investment amount criteria. The aid intensity is according to the regional aid map.

Non-regional aid from Hungarian Funds:

Subsidy can be obtained – based on individual Government decisions - for R&D projects that last a minimum of one and a maximum of three years, with a minimum of 3M EUR in eligible costs. The aid intensity is up to 25 % of the eligible costs, and the maximum available subsidy is 15M EUR. At least 25 new R&D-related jobs have to be created (50 % of the new jobs created have to be employees with higher education). “VIP” training subsidy is offered for the training of a company’s own employees. The subsidy is available to investors creating at least 50 new jobs in Hungary. Aid intensity is a maximum of 50 % of the eligible costs. The subsidy amount is limited by the total number of training participants (varies between 0.5-2M EUR subsidy per project) and by a maximum average limit per participant (3,000 EUR subsidy per participant).

To join the INPUT Program is also available, what aims to facilitate the transformation and growth of the Hungarian startup ecosystem by helping brave individuals to build new and sustainable ventures and by supporting already existing enterprises.

Sources of private sector finance for innovation projects

In recent years, Budapest has seen an increasing participation from some of the large companies that it helped give rise to, including MKB Bank (one of Hungary’s largest commercial banks) and MOL Group (Central and Eastern Europe’s second largest company). MKB Bank, for example, launched an incubator specifically for fintech companies (Fintechlab) that completed its first batch of start-ups in July 2017. Even more recently, multi-national oil and gas company MOL Group announced a partnership with Budapest’s Design Terminal — one of the city’s leading incubation ecosystems — to bring innovative ideas to the company and help disruptive start-ups scale up their activities. In addition, Deutsche Telekom has also worked closely with Kitchen Budapest — the innovation lab that helped launch Prezi.

Currently, entrepreneurs in Budapest have a few options for local funding. Day One Capital, for example, is an early-stage investor that manages privately financed funds to invest in countries within the CEE. Other active venture funds include Baconsult, Digital Factory, A3 Ventures and Buran Venture Capital. Moreover, leaders of local success stories have begun investing and taking more active roles within the ecosystem.

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Positive example of initiative undertaken in the region

Industry 4.0 Model Factory and Technology Centre were established in 2017 with the support of IFKA (Public Benefit Non-Profit Ltd.) and IVSZ (ICT Association of Hungary). The aim of the project is to raise awareness and demonstrate industrial automation and production systems and develop national SMEs. [18,19]

- Industry 4.0 model factories: Within the project management concepts (e.g. lean), business solutions and technologies (e.g. MES, collaborative robots,

RFID) are presented with by five Industry 4.0 model factories, four of them in Central Hungary and one operates in West Transdanubia region. Model factories include SMEs and large companies, process and discrete production.

- Industry 4.0 Technology Centre: It is run by the Budapest University of Technology and Economics with the help of GINOP 1.1.3-16 project. It ensures demonstration and development services. The purpose of this service is to compile and demonstrate an Industry 4.0 knowledge base for SMEs within the available resources and help them prepare for Industry 4.0 and selecting the most appropriate technology. The technologies presented include data collection, optimisation, automation, and infrastructure.

LogMeIn's product portfolio has evolved from remote access software products but as a result of the company's innovations and acquisitions it now covers almost the entire spectrum of the Software-as-a-Service (SaaS) industry. While in 1998 LogMeIn were among the first start-ups in Hungary, today they are counted among the Top 10 SaaS IT corporations globally. LogMeIn have a team of almost 4000 people working on four continents and our shares are traded on NASDAQ, one of the most important stock exchanges of the USA.

Prezi founded in Budapest in 2009 by CEO Peter Arvai, CTO Péter Halácsy, and CTO and Principal Artist Adam Somlai-Fischer, a web-based presentation software, would go on to be Hungary's biggest success story to date. The success of Prezi, Hungary's first Unicorn, would not only place Budapest, and in turn Hungary on the map of international investors, but along with the teams of other home-grown tech successes like Ustream and LogMeIn, the founding team would be very influential in the start-up ecosystem themselves. As well as investing a lot of time, resources and capital into turning Budapest into a tech hub, the founders of these three companies set up Bridge Budapest, a six-month fellowship program for promising tech talent in Hungary. The founding team of Prezi, who opened an office in San Francisco straight off the bat in 2009, are praised for having brought an essential part of the start-up culture from Silicon Valley back with them to their home country, and trying to install this entrepreneurial mind-set in the next generation of talent too. [20]

Another success story Turbine.AI which was recognised as the top health start-up of 2017 at the Pioneers Festival in Vienna, in addition to others like BitRise which was the first Hungarian start-up to get into Y Combinator, the future for Budapest looks promising. Entrepreneurs who have tried in the international arena are returning home and bringing lessons to share with their peers. [20]

The Áldomás community food brand has been created in close cooperation between small and medium-sized food producers and the Hungarian National Trading House. The project aims to improve the competitiveness of small and medium-sized Hungarian food producers in international markets by promoting food products with high nutritional value, ensuring GMO-free and high-value products. Promoting their products under the Áldomás community brand allows member companies to communicate the values of their products effectively and to share logistics and marketing costs. For many, joining the brand represents the first step in internationalising their business. The Hungarian National Trading House provides continuous feedback on the market performance of the respective products. This serves as a basis for further product development and contributes to future competitiveness. By the end of 2016, 39 products from 34 producers had joined the Áldomás community brand and another 94 products were in the process of prequalification or packaging development. The Áldomás brand was presented in 20

different international exhibitions in the last year. 10 seminars have already been held all over the country introducing the project to producers and emphasising the importance of informed buyer decisions. Compared to the expected results, the programme's budget is small, at around EUR 55 000.

2.2.7 Latvia

Latvia has a unique geographical and cultural position, providing a strategic location for business operations targeting developed economies of the EU and emerging markets of eastern neighbours. Latvia is a natural gateway between the US, EU and Asia (especially Russia/CIS). Advantages enabling successful trade include:

- Advanced transport infrastructure

Located on the coast of the Baltic Sea, Latvia has three major ice-free international ports—Riga, Liepaja and Ventspils—that are closely linked into the country's land-based infrastructure, including an extensive rail, road and pipeline system.

Riga International Airport is the largest airport in the Baltics and in 2017 it served 6.09M passengers breaking the annual passenger record (+12.9 % y-o-y growth) and handled 25 525 tonnes of cargo. Riga International Airport serves almost half (49 %) of all Baltic capital passengers. In comparison, in 2017 Tallinn (Estonia) served 21 % of total number of passengers and Vilnius (Lithuania) served 30 %. The airport currently serves 19 airlines, including Latvia's national airline *airBaltic*, low-fare carriers *Ryanair*, *Wizzair*, *Norwegian*, and European leaders like *Lufthansa*, *Aeroflot*, *Turkish Airlines*, *SAS* and *Finnair*. The said companies and others ensure fast and reliable direct travel from Riga International Airport to almost 80 destinations in winter season and around 100 destinations in summer season.

- Free trade

Latvia's external [trade and customs policy](#) is based on free trade principles. Latvia is an EU country, a member of Schengen and an active participant of the World Trade Organisation, enjoying all the benefits of free and open trade in the world's markets. Customs and border procedures have been standardised for effective planning and coordination with trade partners around the world. Furthermore, Latvia has also become a full-fledged OECD member.

- Export experience and support

Domestic companies continue to develop their exports, creating an environment of knowledge and ability that enable firms to grow their businesses in Latvia and abroad. Latvia's history has prepared its workforce with knowledge of business and cultural norms that enable partnership with Western European countries, and particularly with Russia and other CIS countries. LIDA provides a host of [services](#) for assisting locally-registered companies to find and cultivate new markets.

Latvia displays a mixed performance in digital transformation. Out of a total of seven dimensions (Integration of Digital Technology, Changes in ICT Start-ups environment, Entrepreneurial culture, e-Leadership, Supply and demand of digital skills, Investments and access finance, Digital infrastructure), Latvia scores above the EU average in ICT start-ups and entrepreneurial culture. There is however room for improvements in every other areas especially digital infrastructure and investments and access to finance. Latvia has over the last years implemented various measures to support digital start-ups, including financial support programmes and through competence centres.

- Growth and Employment

The Latvian single multi-fund Operational Programme "Growth and Employment" (OP) aims at achieving key national development priorities along with the "Europe 2020" objectives. By combining support from the European Regional Development Fund (ERDF), the Cohesion Fund (CF), the European Social Fund (ESF) and the specific allocation for the Youth Employment Initiative (YEI), the OP will provide a significant support to the economic growth and employment, with a particular focus on the competitiveness of Latvia's economy.

Funding priorities

In Latvia there are more than 50 higher education institutions. Out of them 12 universities offered to register in single enrolment electronic system. In 2017 in the first place potential students had chosen **Information technology** as the primary programme. Out of them in 9 it is possible to master knowledge in several directions in Information Technology, such as: computer science, programming, automation, information technology for sustainable development, cyber security and programming, development of virtual reality and mobile systems. Education related to Information technologies can be gained not only in capital of Latvia – Riga, but also in Ventspils, Daugavpils, Cēsis, Liepāja, Valmiera. One of universities – Riga Technical University - offers to learn information technologies in three branches of the university: Cēsis, Daugavpils and Liepāja.

In 2017/2018 school year there were 2008 out of 16,265 places in all programmes for joining the universities to study Information technologies.

There are two science and technology parks:

- **Latvia Technology Park (LTP)** was founded in 1996. There are 11 founders in LTP including Riga Technical University, University of Latvia, Ministry of Economy of the Republic of Latvia, Riga City Council, Chamber of Commerce and Industry of Latvia.

The main task of LTP is to promote commercialisation of science through modern technologies, to support the start-up and develop technological and innovative businesses, by supporting small and medium-size production companies.

The LTP support entrepreneurs and researchers in management and consulting of projects for business and product development, marketing and partner search.

- The main objective of the Foundation **"Ventspils High Technology Park" (VHTP)** is to provide all the necessary infrastructure and support services for the development of companies that are engaged in the field of high technologies and perform its activity in the city or region of Ventspils.

VHTP started its activity on February 2005. The organisation has several founders, including Ventspils Free Port Authority, Ventspils University College, SIA "Industriālās investīcijas", SIA "Siemens", "Latvian Electrical Engineering and Electronics Industry Association", "Association of Mechanical Engineering and Metalworking Industries of Latvia", and Zernike Group B.V.

The priority fields of VHTP are IT, telecommunications, electronics, mechanical engineering, industrial automation, computer-aided design, and space technologies.

Latvian IT Cluster, which creates a value network of Latvian companies, providing reliable IS development and application services for export. Mission is to increase

competitiveness and growth of IS and IT services export through promotion of collaboration between companies on the basis of the shared vision.

There are also several platforms for start-ups:

- **Labs of Latvia** is a start-up community platform providing information from and about Latvian start-up scene to the world. Labs of Latvia platform provides a powerful visibility tool to reach investors, media and partners that want to work with Latvian start-ups. They also supply start-up news, event calendar and other useful materials from and for Latvian start-ups.
- **Latvian Startup association (NGO) Startin.LV** was created in 2016 to unite Latvian startup community around common values and provide joint opinion with the aim to develop better startup ecosystem in Latvia. Startin.LV is a platform that enables startups to initiate ideas, be heard, receive support in fulfilling their needs and solving problems.
- **TechChill Community.** Building a startup ecosystem is about connecting the communities and working for a common goal. The driving force behind TechChill is a handful of people with an endless passion for startups.
- **Startup Wise Guys** accelerator is an intense, high energy, no BS, straightforward approach to coaching from practitioners not consultants! It's a 3 months long on-site Mentors driven programme taking place in either Tallinn (Estonia) or Riga (Latvia). Accelerator is primarily sales and scaling focused with a fundraising component helping teams be in a position to raise the next funding round within 6 months. As of this year we have two verticals – B2B SaaS and Fintech.
- The **Digital Freedom Festival** is a multi-event platform where the geeks of the digital era meet with policymakers to solve problems caused by the clash of the digital and analogue worlds. Investors and technology evangelists connect with young, bright minds of the start-up scene, and consumers discuss the impact of technology on our lifestyles.

There are two communities, which focus on sharing experience in information technology and discussing actual topics:

- **DevClub.lv** is community of LV IT specialists. We are gathering on Monthly events, discussing for LV IT developers important topics and sharing of experience. 2-3 topics are provided at every event with coffee/beer breaks for networking and communication. Events are Free to attend for everybody. Presentations have been filmed and are available on our website. Presentation language – English, Latvian or Russian.
- **Riga Tech Girls.** The first community in Latvia dedicated to educating and inspiring girls & women about technology. Riga TechGirls is the first community in Latvia dedicated to educating and inspiring girls & women about technology. They love technology and are passionate about the contribution women can make for technology field. When girls develop digital skills, they are empowered to become architects of the future.

Latvia ranks 19th in DESI 2017. Compared with one year ago, overall progress is driven by increasing shares of fast broadband subscriptions as well as by improved delivery of public services. More and more Latvians are going online and are using e-Government services, but half of the population still has no or low digital skills.

Latvians are increasingly shopping online, but businesses are exploiting technology in a limited way. Latvia belongs to the medium performing cluster of countries.

On 1 October 2013, Latvia approved Information Society Development Guidelines for 2014 -2020, elaborated to determine priorities in the area of Information and Communication Technology for the European Union Structural Funds Programming period for 2014-2020.

ICT training for small and micro enterprises for raising competitiveness and productivity

Latvian Information and Communication Technology Association (LIKTA) invites small and micro enterprises as well as self-employed persons to participate in the training project "Training of small and micro enterprises for the development of innovations and digital technologies in Latvia" (project No 1.2.2.3/16/I/002), which is being implemented in cooperation with the Central Finance and Contracting Agency (CFLA).

The project is implemented in the European Union Regional Development Fund activity 1.2.2.3. "Supporting ICT and non-technological training as well as training for attracting investors". The aim of the project is to promote entrepreneurs understanding of innovations and increase the qualification of small and micro enterprise (MMU) employees and self-employed, thus promoting the introduction of technological innovations and increasing work efficiency and productivity.

During the project, training will be provided in the following thematic blocks (2016-2020):

- Digital technology
- Digitalisation of internal processes of the company
- Digital tools for the development of production and services. The purpose of the planned module training is to provide MMU staff with the opportunity to test new ICT tools and technologies by learning small groups and receiving experienced lecturers.

The practical tasks will be tailored to the real business situations of the company, thus promoting the participants' understanding of how new technologies and tools will be able to improve the company's internal processes, to increase the production of products and services, to implement e-commerce solutions, to find new markets, to improve productivity and competitiveness.

In total, it is planned to train more than 6,200 small and micro enterprise executives and employees and self-employed persons.

Duration of the project: December 2016 - December 2020.

In the Integration of Digital Technology by businesses dimension, Latvia ranks 25th, up from 26th last year, but is not closing the gap with the EU. The share of enterprises purchasing at least one of the following cloud computing services, database hosting, accounting software applications, etc., is stable at 6 % of enterprises. Despite citizens' increased interest in eCommerce activities, very few SMEs make use of electronic sales channels, with only 8 % of SMEs selling on-line. Those which do engage in eCommerce, however, make significant turnover from online sales, 8.2 % of their turnover versus the 9.4 % in the EU average.

Demand-side barriers regarding the implementation of digital transformation

Latvia, however, has a relatively weak performance in access to finance and regarding the level of supply and demand of digital skills and competences. In addition, Latvia has its lowest score in digital infrastructure, which is relevant for providing connectivity to Latvian industries and businesses. Overall, Latvia provides a mixed performance with relatively good performances in ICT start-ups and entrepreneurial culture, and low and very low performances in the other five fields (Integration of Digital Technology, Digital Infrastructure, Investments and access to finance, Supply and demand of digital skills, e-Leadership).

The other aspect is that there is no order on a country level for industry specific controls in place. For example, it is not developed and ordered the process of paper certificates of origin move to digitalised document for products.

Latvia's market size: it is fairly small and transfer to digitalisation for big and small company with respect to costs is equal, but the gain for both companies is different. Expenses for digitalisation project have to be considered also taking into account the company's size (not always the smaller the company, the less expenses it requires for digitalisation). Funding availability is hence one of the barriers.

Structural macro-economic barriers

In 2017 unemployment rate dropped to 8.7 % of the economically active population. It is by 0.9 percentage points lower than in 2016, according to the data from the Central Statistical Bureau's Labour Force Survey. In the 1st quarter of 2018, the unemployment rate in Latvia was 8.2 %, according to the results of the Central Statistical Bureau's (CSB) Labour Force Survey.

The increase in remuneration during the last year has been observed in most posts and business sectors, however, some areas also show a reduction. Analysing the increase in remuneration according to the number of employees of the company, it is concluded that the fastest growth was in medium and large enterprises - by 6 %, where the average salary was 881 EUR and 891 EUR net, while in small enterprises - 4 %. The data obtained in the study also allows us to conclude that the largest salaries are in international private companies - 969 EUR in net and local private sector companies - 799 EUR, while the remuneration in the state and local government sectors, including their capital companies, amounted to an average of 700 EUR per net.

Sources of available public finance for innovation projects

Latvia's broadband coverage, in particular NGA, illustrates the urban-rural digital divide. Currently, broadband deployment, in particular in rural areas, is supported with by ESIF co-funding. However, regulatory support to NGA deployment is not fully in place as the transposition of the Cost Reduction Directive has suffered significant delays.

Latvia does not have an overarching strategy in place for the digitisation of businesses. This being said, there are several actions supporting digital entrepreneurship in place and Latvia has achieved a relatively good performance in ICT startups.¹⁴ The Latvian Government aims to restructure its economy by making use of technology to improve businesses, both in terms of modernising more traditional businesses as well as facilitating digital entrepreneurship. The Government is planning to grant innovation vouchers that would ensure 60 % national co-funding for R&D research and product testing.

LIDA Funding: The total funding from the European Regional Development Fund is EUR 2,900,000. Support is provided for in the "Growth and Employment" Operational Programme 1.2.2. the specific support objective "To promote the introduction of innovations in enterprises" 1.2.2.3. LIDA project No.1.2.2.3 / 16 / I / 003 "Implementation of training for attraction of foreign investors" (according to the agreement between the LIDA and the LIDA on 19 December 2016), "Support to ICT and non-technological training as well as training for attracting investors" Agreement between the central financial and contractual agencies on the implementation of the project). The selection of training project applications started on 1 February 2017.

Implementation of the project "Innovation Motivation Program". On 14 November 2016, the Latvian Investment and Development Agency (LIDA) and the Central Finance and Contracting Agency (CFLA) signed an agreement on the implementation of the project "Innovation Motivation Program" (identification No.1.2.2.2./16/I/001). In the first six months of 2018, the LIDA "Innovation Motivation Program" continues to actively organise activities in order to achieve the goals set in the Action Plan. Within the framework of the program, activities have been carried out for various target groups of the society and several procurement contracts have been concluded on the long-term implementation of the activities.

On May 8, the "DEMOLA Latvia 2018" spring season ended, with the final presentation of the 10 issues of various companies presented by Ominava (2 problem situations), Foodio LV, Cljan Rite-Hite Latvia, 123 Drivers, the State Employment Agency, KPMG, Swedbank, Forevers, 4finance. Over the last four months, we have been working actively with teams and affiliates to achieve our goals and successfully develop concise solutions to the challenges presented.

Within the framework of the LIDA Innovation Motivation Program, participated in the business simulation competition "Business 24h" organised by the Banking Institution of Higher Education, in which as many as 600 participants participated. Within the framework of the competition, at several events LIDA informed young people about the services of LIDA and the possibilities for starting a business. In the final, the team of L & V became the winners, creating lamps with Latvian signs in honour of the centenary of Latvia.

European Regional Development Fund - ERDF funding is foreseen for the following activities:

- To improve the business environment and increase competitiveness, especially in small and medium-sized enterprises
- Local economies, incl. tourism and cultural heritage
- Research and technological development
- Local, regional transport, telecommunications and energy networks and the development of inclusive infrastructure
- protection and development of the environment
- Raising the potential of research, science and technology, etc.

The Central Finance and Contracting Agency organises Operational Program "Growth and Jobs" 1.1.1. specific support objective "To increase the research and innovation capacity of Latvian scientific institutions and the ability to attract external financing by investing in human resources and infrastructure" 1.1.1.1. "Practical study of the event".

Sources of private sector finance for innovation projects

LatBan Business angels. There is a lack of both investments and an advice from an experienced entrepreneur, LatBan Business angels will help to enthusiastic business leader with a perspective business project and for purposeful and ready to persistently move forward to implement the project. Apply business project for the Investment Session organised by the association “Latvian Business Angel Network”. In the one of next sessions there will be given an opportunity to present the business project to Latvian business angels that are ready to provide investments. According to a discussion with the board of the organisation of Business Angel Network, there have been projects to automate and digitalise the business process, in some cases almost all of the processes, in other – just a fraction.

The state-owned development finance body **ALTUM** provides financing support through loans, credit guarantees and investments in venture capital funds. ALTUM’s objective is to compensate for existing market shortcomings, to help facilitate business growth and to ensure economic development. Among several support programmes, ALTUM offers:

- Business Start-up Programme: loan for businesses or start-ups established within a period of the previous 3 years
- Loans for Business Angels Co-financed Projects: loans for new projects and enterprises with growth potential
- SME Growth Loans: loans for investment and working capital.

The areas of operation cover support for business start-ups and self-employment, improvement of competitiveness and implementation of **technologies and innovation** and export facilitation. ALTUM also offers non-financial support through education, mentoring and consultations etc. ALTUM’s shareholders include the Republic of Latvia’s Ministry of Finance, the Ministry of Agriculture and the Ministry of Economics.

- *IT Competence Centre*

The IT Competence Centre was created in 2010 based on a signed contract with the Latvian Investment and Development Agency. It aims to promote long-term collaboration between industry and research institutions. On this background, it seeks to create innovative technologies and prototypes of IT products that are competitive at the international level. The IT Competence Centre was established to better implement existing knowledge and technology findings as well as to use the Latvian research potential to improve new technologies and enter new markets. The public-private initiative, which has a national coverage, provides funding for collaborative research projects. The IT Competence Centre’s main research directions are business process analysis technologies and natural language technologies. The Centre is organised by leading Latvian IT companies and universities and co-financed by the European Regional Development Fund.

Positive and negative examples of initiatives undertaken in the region

Amongst positive examples of initiative undertaken by Latvian region, following must be mentioned:

- Simplified electronic signature technology
- Mobile e-signature is now more user-friendly

- Hackatons (Latvian IT Cluster initiative) was a superb success that was channelled towards collaboration between the IT sector and other industries. It is also one of the national priorities as defined by the state.

Amongst the least positive experiences there are to be mentioned:

- Drone usability for pragmatic purposes. Legislation is not adapted. Economies of scale do not promote the evolution of the sector (the areas are fairly small, it hence does not pay off)
- Seminars that are not followed by concrete action. The realisation from the market players is that there is a lot of theory and less so of practical work.

2.2.8 Lithuania

General description of the region

Lithuania's economy has been both consistent and resilient in recent years, effectively recovering from the 2008 financial crisis that affected many EU member states so heavily. Since 2011, the country has achieved an impressive growth rate of four per cent per year and it joined the Eurozone in 2015. In order to ensure further progress, the government plans to encourage increased public and private funding in business projects over the next three years. The goal is to make Lithuania a hub for innovative technology and finance in order to help new businesses and talented entrepreneurs grow.

Vilnius region is located in south east of Lithuania and is the busiest region in the country. The biggest cities are Vilnius, Ukmergė, Švenčionys, Širvintos, Elektrėnai, Trakai and Šalčininkai. Vilnius is the capital of Lithuania and its largest city, with a population of 574,147 as of 2018. Vilnius is in the southeast part of Lithuania and is the second largest city in the Baltic states. Vilnius is the seat of the main government institutions of Lithuania and the Vilnius District Municipality.

Lithuania has jumped eleven places since 2013 for the ease of starting a business to 16th place globally in the World Bank's Doing Business Report.

Lithuania's business Ecosystem

Lithuania is a business-friendly country ideal for young entrepreneurs and skilled professionals and trusted by the top corporates such as IBM, Barclays, Western Union, AIG, Nasdaq, Thermo Fisher Scientific, as well as global startups like Uber, Wix.com and many more. Lithuania also succeeds in the Talent, being a country full of ambitious, energetic, skilled and talented young people ready to work. Moreover, the country provides the fastest and safest internet access in Europe. All these conditions combined with a rapidly growing startup ecosystem make the Baltic state an ideal place for companies to set up shop and scale up.

With several high volume A and B series investments into the strongest Lithuanian startups, such as Trafi, Aimbrain, TransferGo and a couple of sizable ICOs made by Monetha, Mysterium Networks and Bankera, the Lithuanian startup ecosystem is showing some real muscle. The country's biggest tech hub, Vilnius Tech Park, which opened last year, has also been a major attraction for startups, which consider moving to Lithuania. After all, it's the biggest tech hub of its kind in the entire CEE region with 9,000 square metres of offices, co-working spaces, cafeterias, conference rooms, and recreational areas. Keep in mind that Vilnius has been chosen as the most affordable European destination by the Independent

Lithuania has the highest educational level of the population in the European Union. 92 % of working age population have higher or secondary education. A big portion of higher education universities, technical institutes and other is located in Vilnius region, making it a very appealing place for companies to source the young talent.

There are two types of higher education institutions in Lithuania – colleges and universities. Colleges are focused on practical training for particular professions. There are 14 public universities, eight private, and one branch campus of a Polish university.

The top two universities in Vilnius region are Vilnius University and Vilnius Gediminas Technical University:

Vilnius University is the largest university in Lithuania and the oldest in the three Baltic states (Lithuania, Latvia and Estonia), Vilnius University is currently ranked 481-490 in the world and 21st in the EECA region. It was founded in 1579 and now has around 20,900 students enrolled, including almost 1,250 international students. The university has more than 150 bilateral agreements with partner institutions and takes part in the Erasmus + exchange program.

Vilnius Gediminas Technical is also located in Vilnius, Vilnius Gediminas Technical University is ranked 701+* in the world and 43rd in EECA. Established in 1956, it is one of the largest state universities in Lithuania and has become known for its expertise in technical and engineering education, with an innovative and international outlook. The university has received a three-star rating in the QS Stars rating system (an opt-in service for universities), achieving the maximum five stars for teaching, facilities and innovation

Pomerania's is host to two out of the top 10 Universities in Poland, those being the Medical University of Gdansk and Gdansk University of Technology (GUT). GUT specialises in industry work and digitisation, where for example the Faculty of Electronics, Telecommunications and Informatics of GUT, has over 200 employees and 3,500 students, and is the biggest ICT graduate school in the north of Poland with over 500 Master graduates and 20 Ph.D. graduates completing their studies at the Faculty every year.

Investment in Vilnius region

Vilnius being the main investment target in Lithuania it is worth mentioning a few facts about the country's appeal – it is one of the fastest developing countries in the European Union. During the period from 2004 to 2014, the GDP of the country increased by 38 %. Since 2012, the country maintains a stable growth of about 3.3 % per annum, which is 30 times higher than the overall EU average.

Lithuania is a member of the Schengen area and the European Union. Since 2015, Lithuania is a member of the Eurozone too.

The Lithuanian tax environment is one of the most favourable environments for the business creation. According to Eurostat, Lithuania had the lowest tax burden – up to 30 % of GDP – in 2012 (27.2 %), followed by Bulgaria and Latvia (both 27.9 %). The highest taxes – more than 40 % of GDP – were in Denmark (48.1 %), Belgium (45.4 %), France (45 %), Sweden (44.2 %), Finland (44.1 %)

Internet in Lithuania is one of the fastest in the world. Lithuanians rapidly employ new technologies and are innovative. Lithuania was the first in the European Union and one of the world's first countries which started using 4G Internet.

It is a particularly urbanely evenly developed country with great infrastructure and "green" cities. In the south part, the most developed industries are agricultural, food and timber. The number of the employed in the food industry is almost twice higher than the national average. You can find all services and institutions necessary for a comfortable life: police, fire station, hospitals or schools even in small towns. Clean air of the region – based on the study "European Green City Index" data from 30 European cities, the capital of Lithuania has the best air quality in Europe.

An educated workforce – the highest educational level of the population in the European Union. 92 % of working age population have higher or secondary education. It has many qualified specialists in the agriculture, food industry, construction, engineering, and technology. The average wage is 864 EUR before taxes, the minimum wage of 400 EUR before taxes.

Digital transformation

Lithuania had a late join into the train of industry digitisation, resulted in SME's having very little organised help from the government in digital transformation. The country had no strategy, tools or measures in developing industries digital transformation. In 2017 Lithuanian Government officially launched Pramonė 4.0 (Industry 4.0) aiming to increase and strengthen the competitiveness and productivity of the Lithuanian industry and to promote the integration of digital solutions and new technologies.

Structural macro-economic barriers

Vilnius unemployment rate (7.5 %) is lower than country's average of 8.2 %. The situation being that employers are facing challenges finding the best employees with right experience and sufficient qualification.

The rise of labour cost in the western part of the region (Słupsk) is not as significant as rate of growth in the Tri-City area. This makes the Słupsk-area more attractive for industry. Unfortunately, infrastructural development of Słupsk is poor. Neither highway, nor express-class railway to Słupsk has been constructed yet, so produced goods do not have adequate transfer lanes from factory to customer. Infrastructural underdevelopment is a fundamental development barrier for the Pomeranian industry outside of the Tri-City.

Sources of available public finance for innovation projects

In the Vilnius region there are numerous co-financing opportunities supporting innovative initiatives.

Subsidies Offered by the Ministry of Agriculture of the Republic of Lithuania - the Ministry of Agriculture of the Republic of Lithuania usually offers financial aid in various forms to micro or small companies engaged in economic activities and seeking to reduce social exclusion and fighting poverty in rural areas. There are several example measures implemented by the Ministry: "Economic and Business Development" area of activity "Support for the Start of Non-agricultural Business in Rural Areas". This financial aid encourages the start of new businesses in rural areas, encourages the economic activity of micro, small enterprises, farmers and other natural individuals in rural areas, covering various non-agricultural activities, production, processing, marketing, selling, and the provision of various services, including services to agricultural businesses.

"Economic and Business Development" area of activity "Support for investments Aimed at the Creation and Development of Non-agricultural Activities", "Support for Investment Aimed at the Creation and Development of Economic Activities". This

financial aid supports the creation, development, diversification, and maintenance of economic activities. Under the measure, support is provided for non-agricultural activities, production, processing, marketing of products, as well as the provision of services, including services to agricultural businesses.

“Leader” subsidy – the measure is implemented in line with the bottom-up approach to reduce social exclusion, poverty, and unemployment while diversifying economic activities in rural areas. i.e. The measure is implemented in accordance with local development strategies, developed and adapted to the specific rural area of Lithuania. Financial Aid to Compensate the Payment for Guarantee (Credits)

A financial support measure aimed at facilitating the use of credit by rural actors for investment projects by reimbursing part of the guarantee fee.

Subsidies Offered by Invega – INVEGA (investment and business guarantees) aims to promote the growth and competitiveness of Small and Medium-sized Enterprises by implementing various financial measures, such as soft loans, loan guarantees, interest rate subsidies, and support for the first job and finance of consultancy expenses.

Soft Loans. INVEGA manages soft loan financial instruments financed by the European Structural and Investment Funds (ESIF) and resources returned, allowing SMEs to start or expand their activities. Different types of loans provided by financial institutions are offered under different conditions. The best option to enhance an SME’s access to finance is chosen according to the amount of the financial support needed and payment provisions.

The Entrepreneurship Promotion Fund 2014—2020 (EPF2) offers soft loans for start-ups of up to EUR 25,000. A loan guarantee may be requested from INVEGA.

The Open Credit Fund 2 (OCF2) offers soft loans for SMEs of up to 600,000 EUR. A loan guarantee may be requested from INVEGA. In addition, you can use the measure Partial financing of interest and receive a compensation of 50-95 % of the interest actually paid up to 36 months.

Risk-Shared Loans (RSL) financed by the European Regional Development Fund offer loans for SMEs of up to 4M EUR. The RSL measure is based on the principle of lending with the proportion of 45:55, under which the RSL Measure Manager contributes by 55 % of its own funds to 45 % of the RSL loan/credit line share.

Loan Guarantees. Businesses applying to banks and other credit institutions for loans to start or grow their business often face the challenge of collateral not being attractive or adequate enough for the bank or credit institution. INVEGA helps to overcome this challenge by guaranteeing financial intermediaries the repayment of up to 80 % of the first loan. The bank secures the repayment of the remainder of the loan with collateral offered by the enterprise.

Partial Financing of Loan Interest. Partial financing of interest allows businesses that receive financial support in the form of non-repayable subsidies to reduce the burden of obtaining financing while cutting costs and facilitating the planning of business development. Businesses can make use of the opportunities offered by the Interest Rate Subsidies instrument to cover up to 95 % of the interest paid on loans, both guaranteed and not guaranteed by INVEGA.

Support for Employment. Under the Support for Employment instrument employers that hire individuals encountering difficulties in the labour market are entitled to a compensation of wage costs. Within the framework of the project Support for the

First Job employers who hire individuals with no prior work experience may be partially reimbursed for salary costs associated with the first-time employment of young person (up to 23.3 % from the salary calculated).

Financing of Consultancy and Training:

- **EXPO Consultant LT** – Support of 4,000 EUR to cover the costs of export-related consultations over a period of six months
- **Business Consultation** – Support of 2,000 EUR to cover the costs of business consultations over a period of six months
- **Staff Training** – Up to 4,500 EUR can be compensated for the costs of employee training over a period of 12 months.

Alternative Sources of Financing

Lithuanian Risk and Private Equity Companies – one of the sources of business financing is venture capital funding. Venture capital funds invest in businesses that are looking for viable business projects with fast growth potential and focused on global markets.

Business Loans by Banks and Credit Unions – the most popular sources of financing business activities are bank loans and credit union loans. Loans are usually given to longer term and the loan itself is bigger. This financing option is more often available to older and larger companies, as credit institutions require collaterals and high-risk assessment requirements are applied. However, loans from credit institutions stand as quite a cheap option.

Business Loans by other Credit Institutions – other credit institutions that are not considered to be traditional 'banks' may also issue loans. Usually they apply quite flexible and fast risk assessment processes. However, the loans might be more expensive in terms of rates of interest and administrative fees than those applied by traditional banks.

Peer-to-Peer (P2P) Financing and Crowdfunding - in the peer-to-peer lending model, investors, who are usually private individuals, lend money to other individuals or businesses or finance a company's project in a form of a loan via a special P2P platform. Loans might be secured by mortgages or a CEO guarantee from the borrower. There are several P2P and crowdfunding platforms operating in Lithuania that grant access to business loans: FinBee, SAVY, LENNDY.

Positive and negative examples of initiatives undertaken in the region

Vilnius is the centre for businesses with focus on high added value products and services. Deeper is one of Lithuania's most successful and innovative tech companies With sales in over 50 markets worldwide and 12 international awards.

The company's flagship product, the Deeper Sonar, was launched in 2013, creating an entirely new product category in the angling sector. It put detailed sonar data into the hands of shore anglers for the first time ever, by pairing the castable sonar device with the angler's smartphone.

Since then, Deeper has added two new higher-spec models and three accessories to its product portfolio. Designed, developed and manufactured in Lithuania, these products are now sold in over 50 markets globally, and have picked up 12 international awards. Most notably, in 2016 Deeper Sonar won an Innovation Award at the Consumer Electronics Show, with other winners that year including Samsung, Lenovo and HP.

Despite this success, Deeper has strong ambitions for further expansion. It's experienced R&D team have been developing Deeper Lock, a next generation bike security system, for the past 2 years. Set for production in 2018, it offers urban cyclists an advanced security system for the bikes, with GPS tracking, anti-theft alerts, keyless locking and a 110dB alarm.

With Deeper Lock, plus a new model of the Deeper Sonar, launching soon, this rapidly expanding company is set for further dynamic growth.

Despite successful and innovative businesses, there are stories to be mentioned as a bad example. Blockchain is a promising technology that has very few sceptics, but the crypto currency market with its difficulties has the potential for frauds and shady businesses to arise. The hype for get-rich-quick by investing in crypto currencies has inspired local entrepreneur to setup a company that mines crypto currency and had raised over 6 million euros. The head of company had an aggressive marketing campaign, starting a brand new Lamborghini Huracan, promising investors a quick success to get their own Lamborghinis. The journey ended 8 months later, resulting a numerous authority raids and seize of the assets, including the famous supercar.

2.2.9 Malta

Malta ("the Country" or "the Island") is one of the smallest but most densely populated countries in the world, with around 475,000 residents living in an area of approximately 316km². Given its size, Malta is not considered to be divided into regions, with the exception of the sister island of Gozo. Since Malta's entry into the EU in 2004, the country's opportunities and prospects expanded significantly allowing Malta, the EU's smallest economy, to become one of Europe's fastest growing economies. Malta has been reported as "one of the fastest-growing economies in Europe" (IMF, 2016), having a real GDP growth of 3.4% as of 2017.

The Maltese economy can be segregated in the following main sectors:

- **Tourism:** Landmark number of tourists in 2016 of almost 2 million, circa 4 times the local population
- **Aviation:** The local economy is equipped with all the necessary services for aircraft operations with aircraft manufacturers, operators, and ancillary service providers based in two dedicated aviation parks.
- **Maritime:** One of the largest ship registers in the world. It is well-connected and set up for sea transportation, offering various berthing, ancillary and other services to owners of private vessels and superyachts.
- **Wholesale and retail trade, transportation and accommodation:** This sector is the highest contributor to Gross Value Added ("GVA"). It makes up 22.0% of the total percentage of GVA for 2017, as seen in the below chart.
- **Professional, scientific and technical activities:** This sector makes up 15.2% of Malta's total GVA.
- **Manufacturing, and electricity and water supply:** Manufacturing is the fifth highest contributing industry for the economy's GDP. In fact, this makes up 10.2% of the total GVA, including electricity and water supply.
- **Information and communication:** This makes up 6.6% of the total GVA as at 2017 even though this is a relatively new sector in the Maltese economy.

- **Financial and insurance activities:** Malta is a long-standing international financial services hub with the financial sector solely accounting for 6.2% of Malta's GVA, based on latest figures available at the National Statistics office ("NSO"), which is much higher than the 2017 EU average of 2.5%.
- **Real estate activities:** Malta's property market has been growing better than most European markets. Malta is growing as a presence for international finance, life sciences, as well as digital and creative industries, attracting foreign firms and professionals to the Island. This resulted in a demand across all areas of the real estate sector, especially the residential and office area. In fact, this sector still only makes up 4.9% of the total GVA of the Country, which is at a 3.8% higher than the EU average.
- **Construction:** The construction and real estate industries are flourishing due to the recent influx of foreigners who have relocated to Malta to work. The influx of foreign nationals has also bolstered growth in the local retail sector. This makes up around 3.6% of the GVA which is approximately half of the EU average of 6.3%.
- **Agriculture, forestry and fishing:** This represents 1.1% of the total GVA of the economy. This falls far below the EU average of 4.4%. This sector is very small compared to the other European countries due to our small size, but it is diverse. Most farms are small and privately owned, with most of the crops and other foods produced being consumed domestically.

Malta's smart specialisation areas consist of: ICT;

- Services
- Human health and social work activities
- Construction and
- Key Enabling Technologies.

Malta's National Research and Innovation ("R&I") Strategy 2020 also comments about these areas, stating "[a]s a small country with a young R&I system characterised by very limited resources, Malta needs to balance the establishment of a fully-fledged R&I support system with the need to focus its resources on a reduced set of priority niche areas selected on the basis of unique selling points and indigenous strengths". In identifying the areas where specialisation is required, it is important to identify where these areas and other priority areas interact.

ICT has a very important role in this, in order to build Malta's knowledge economy. The continued investment in specialised skills in the technology field is crucial, especially in the Health, Digital Gaming, Financial Services and Tourism product development sectors. The National Research and Innovation Strategy 2020 highlights the challenges behind identifying Malta's smart specialisation areas:

- The national system of innovation is still being developed and the history of investment in innovation and research is relatively short
- Specialisation patterns are subject to change rapidly due to the data sensitivity to fluctuations and
- Pronounced risks of overspecialisation, resulting in loss of resilience.

With this in mind, the main smart specialisation areas identified in this report are:

- Tourism product development

- Maritime services
- Aviation and aerospace
- Health with a focus on healthy living and active ageing, and e-health
- Resource-efficient buildings
- High value-added manufacturing with a focus on processes and design and
- Aquaculture.

Malta's strong economic growth led to higher demands for increased workforce, which led to record low levels of unemployment. The Government of Malta has introduced a number of measures to increase workforce participation in Malta, such as the introduction of free childcare services, which increased female participation.

The unemployment rate in Malta has decreased significantly over the past three years. As at 2017, the rate stood at 4.5%, while in 2015 this was at 5.9%. Professionals and practitioner specialising in information and digital technology are in high demand due to the increase in companies operating in this field, and this will keep on increasing in the far future. It is forecasted that by 2020¹³, more than 800,000 new age jobs will be unfilled all over Europe. Even though demand for professionals is very high, the current education system is not what the industry requires. The digital skills being taught are not matching the standards that are needed in the industry. There is a shortage in the supply of workers for the IT and digital companies. The attraction of a better pay abroad also results in this shortage. Currently, various employers are facing difficulties. The Government is trying to encourage more students by offering higher stipends in this field of study.

Various institutions offer course in Information and Communication Technology ("ICT"). Six of the most common institutions, offering from diplomas to doctorates, are the University of Malta ("UoM"), St. Martin's Institute of Higher Education ("SMI"), Malta College of Arts Science and Technology ("MCAST"), Institute of Computer Education ("ICE") Malta, STC Malta ("STC") and Middlesex University ("MDX") Malta. Courses offered around Malta include both basic ICT and Computer Science, as well as research based studies in Artificial Intelligence ("AI") and Microelectronics and Nanoelectronics¹⁴ which are fields lacking in Malta.

The total number of students graduating from the UoM (at any level) as at 2017 amounted to 11,323 students¹⁵. 378 of these graduates were from the Faculty of Information and Communication Technology. This rate stood at 8.5%¹⁶ of all those completing tertiary education. However, during 2016, Malta witnessed a 1.7% fall in this percentage.

Currently, Malta has numerous initiatives in place. One such initiative is that for children, where the Malta Communication Authority ("MCA") and the Ministry for Education and Employment offer regular coding lessons and annual coding events, such as the Hour of Code and Malta Robotics Olympiad. The MCA also offers learning

¹³ "Press Release by the Ministry for Competitiveness and Digital, Maritime and Services Economy and the Ministry for Education and Employment: Ministers Emmanuel Mallia and Evarist Bartolo address ICT and education professionals at an eSkills seminar", Government of Malta, Accessed on 8th October 2018.

¹⁴ "Faculty of ICT", L- Università ta' Malta, Accessed on 8th October 2018.

¹⁵ "Student Statistics by F/I/C/S, Course & Route – 2017/8", L-Università ta' Malta, 2017-18.

¹⁶ "Distribution of graduates at education level and programme orientation by sex and field of education", Eurostat, Accessed on 8th October 2018.

sessions, together with the Malta Information Technology Agency ("MITA"), for the elderly to boost their basic digital skills. Other initiatives such as the EU Safer Internet Programme and Cyber Security are in place.

The One Tablet Per Child ("OTPC") scheme has been established by the Maltese Government under the EU funds for Malta 2014-2020 strategy, ensuring that every child in the fourth years of a primary school across Malta will be given a fair and equal opportunity to be closer to technology, no matter where they come from or who they are. These children will be given a LearnPad Workbook 10.1 inch tablet as a learning tool to help them achieve various educational objectives. Alongside this initiative, teachers have quick and easy access to numerous organised school-focused resources through ClassConnect.

Another initiative is that taken by the eSkills Malta Foundation. This was set up for numerous activities including, but not limited to, *"to contribute to the expansion of ICT educational programmes and related informative initiatives"*, *"to lead an ICT professionalism development programme"*, and *"to instigate further reform in the ICT educational offerings and contribute to capacity-building in the ICT education community"*¹⁷.

Malta ranks 12th out of the 28 members of the EU in the Digital Economy and Society Index 2017 ("DESI 2017"). Malta performs above EU average for broadband connectivity, ranking ninth out of all the EU Members. In fact, the Maltese Islands are considered a European leader in fast broadband and the most advanced Member State with all households covered by at least 30 Mbps Next Generation Networks ("NGA") broadband.

A number of demand driven initiatives being undertaken in Malta, as set out by the Gigabit Society, include the MCA Free Wi-Fi project which aims at making Malta the EU's first Wi-Fi Member. Another such initiative is the SmartPhone Initiative, aiming at promoting the smart phone as a productive tool. These initiatives form a part of the wider goal the MCA Informative Society is aiming to achieve, this being the promotion of e-commerce to Small-to-Medium Enterprises ("SMEs") and micro-companies, while addressing the digital divide currently present in the Country.

Malta is currently trying to improve the Country's international connectivity to encourage foreign business investments. The MCA is trying to establish a new connection between mainland Europe or North Africa. This will ensure that Malta's future international connectivity requirements are being met. Malta has completed the transposition of the Broadband Cost Reduction Directive 2014/61/EU. This will also help encourage innovations and investments in connectivity in Malta.

The Digital Strategy for Malta for the period 2014-2020

The Maltese government introduced the Digital Malta 2014-2020¹⁸ strategy ("the Strategy") aiming at introducing principles and actions (approximately 70 in total) for ICT development by focusing on three main pillars: the Digital Citizen, the Digital Business and the Digital Government. Three driving forces support these pillars: Regulation and Legislation, Infrastructure and Human Capital. ICT can reap many benefits for the local economy including a better education, stronger businesses, sustainable economic growth and more, and the Strategy aims at achieving these.

¹⁷ "About Us", eSkills Malta Foundation, Accessed on 8th October 2018.

¹⁸ "Digital Malta: National Digital Strategy 2014-2020", 2014.

The vision of this Strategy is “*Malta will prosper as a digitally-enabled nation in all sectors of society*”¹⁹.

Malta demand-side barriers for implementation of digital transformation

The use of digital technology is growing rapidly in all types of businesses around Malta and Gozo. However, it is still lacking in certain areas, especially in SMEs. Such areas include the use of eInvoicing and Electronic Information Sharing¹³. The EDPR 2017 states that the use of social media and Radio-frequency identification (“RFID”) technology²⁰ are being used in many businesses in Malta, but only a few of these engage in electronic invoices and other digital technology features. Many SMEs and start-up companies need to be pushed to use digital technology for innovation, reducing costs and as a means to access not only domestic but also global markets. One clear example where innovation is required is in the healthcare services to allow for patient empowerment and a more personalised and safer care.

The main barriers identified for Malta have been listed, inter alia below:

- Skills

According to the EDPR 2017, Malta still shows a mixed picture when it comes to digital skills. The percentage of internet users in Malta (76%) is still below that of the EU average (79%), and unfortunately, the gap between Malta and the EU average is even higher for the case of basic digital skills, where Malta stands at 49% while the EU average is at 56%. On the other hand, Malta lies at a 0.1% higher than the EU average for the percentage of ICT specialists in the Maltese labour force. The number of Science, Technology and Mathematics (“STEM”) graduates that play an important role in exposing and utilising digital technologies to businesses is also below EU average.

The knowledge and skill of the labour force is the main challenge hindering digitisation in Malta. The educational system is contributing to this problem. Teachers need to be knowledgeable in the IT field, using eLearning materials to expose students to sufficient digital content. The young generation needs to be well versed in the technology field to reap the full advantages digitisation will offer in their adult-working life. Students are not the only age group that need to engage in the digital world. Unskilled working-age adults,

the elderly and people with disabilities should also be encouraged to learn this field. The use of eSkills is very beneficial for both earnings and job prospects and offers great potential to bring that percentage of unskilled and unemployed labour back into the workforce. The digital industry has a low female participation rate. Females need to be encouraged to explore the ICT field.

- Innovation

Malta currently ranks as a moderate innovator in the EU Innovator Scoreboard 2017. This is due to the shortfalls present in both human capital and R&I investments. Unfortunately, there is not enough supply of R&I investments to meet the needs of innovation. The Country needs further financing and support when it comes to innovation, as this is what will push the Country forward in the digitisation world. Both companies and the Maltese Government need to spend time and money stimulate digital innovation further.

¹⁹ “eCommerce Malta National Strategy 2014-2020: Mid-term Strategy Update – 2017”, MCA, 2017.

²⁰ “Europe’s Digital Progress Report (EDPR) 2017: Country Profile Malta”, 2017.

- Industry needs

Currently there is a misalignment between what is being taught in the school curriculum and what the industry exactly needs. One such area where this is seen is in iGaming sector. The lack of specialised skills required for this field is not available in the local workforce and therefore this sector cannot advance to where it is required to be. The Baltic region and some Eastern European countries provide a high skilled digital workforce.

- Broadband

As mentioned above, Malta is considered a European leader in fast broadband and the most advanced Member State. The national technological infrastructure is in good shape. Malta has an impressive fixed telephony market (dominated by GO plc. and Melita¹⁵) and internet access. The main concern in this area is the affordability of broadband for users. The broadband packages for users offered in Malta are expensive compared to the exact same packages offered by other European countries.¹⁶ Other areas cause concern are the dependence on foreign countries for internet connectivity, the capacity of this international connectivity and the lack of local content for the web and mobile devices.

The structural macroeconomic barriers hindering implementation of industry needs

The digital Maltese economy is experiencing a lack of exposure to potential FDIs and of development in Maltese skills due to the lack in participation and contribution of open source communities. Open source communities refer to computer source code that is made available to the public for use or modification of some sort.

The Country's small size should be creating opportunities in and encouraging the development of digitisation. Highlighting such opportunities and threats to this sustainable growth is needed for more innovative and strategic investments.

- Market Size

Malta's domestic market size, cannot sustain the entire life cycle for a business to grow, especially the research and development stage. Malta therefore works as stabilising itself as a hub for exports, acting as a gateway into the rest of Europe.

As a result, efforts are directed towards direct research to strengthen Malta's digital economy. Open innovation approaches are to be considered, adapting more to the needs of SMEs in the process. The chances of Malta's industrial base to grow competitively depends entirely on the focus given towards education and areas of strength, such as smart specialisation, through means of diversification.

National incentive packages are no longer sufficient to attract investment. There are equally attractive incentive schemes abroad and so investors may seek business opportunities in those countries offering more profitable prospects than those of Malta. Greater focus should be placed on knowledge- and innovation-based investments and economic efficiency. These factors are the best way to create the competitive edge needed in the Country for a sustainable growth in digital innovation.

- Private financing

The small size of the local market is another challenge faced by SMEs in Malta wishing to grow in the digitisation industry. The limited access to financing and the insufficient capacity for innovation hinder any possible growth of such businesses. Another main challenge is the lack of adequate schemes in place for angel investors, which require funding for their start-ups to take off, and for businesses focusing on digitisation.

This may put Malta in a bad light, discouraging innovators and entrepreneurs from opening businesses in the Country.

Sources of available public finance for innovation projects

Several public funding opportunities are available in Malta to provide financing for enterprises and innovative projects, particularly targeted towards start-ups and SMEs. One of the main challenges for Maltese SMEs is the inability to raise capital, and such funding options can thus help these businesses in their operations. The 'Malta Enterprise' is a government agency that promotes international investment in Malta and supports Maltese enterprises. In order to achieve the latter objective, Malta Enterprise launched a number of schemes to financially support local enterprises, particularly start-ups, SMEs and enterprises carrying out innovative projects.

- **Micro Invest:** The objective of this scheme is to encourage investment and innovation through a tax credit representing a percentage of the eligible expenditure and wages of new recruits.
- **Investment Aid Tax Credits 2014-2020:** Financial aid under this scheme may take the form of tax credits and/or cash grants, calculated as a percentage of incurred qualifying expenditure. This is undertaken in order to encourage the setting up of new establishments, and also the expansion and development of existing establishments.
- **Aid for Research and Development Projects (Tax Credits):** This incentive measure provides a tax credit on costs incurred in carrying out a research and development ("R&D") activity, seeking to achieve scientific or technological advancement.
- **Business Start:** This is a seed funding grant targeted towards innovative small start-ups in the early stages of development. Economically viable initiatives are supported through a grant of up to EUR 25,000.
- **Innovation Aid for SMEs:** SMEs qualifying for this incentive may recover up to 50% of the costs incurred from a research and knowledge-dissemination organisation or the secondment of highly qualified personnel.
- **Micro Guarantee Scheme 2017-2020:** In order to facilitate access to debt finance to small businesses, through this scheme Malta Enterprise provides a guarantee of up to 70% on loans. These funds may be used to finance business enhancement, growth and development.
- **Start-Up Finance 2017-2020:** This scheme aims to finance innovative small start-up undertakings in order to support them in the setting-up and initial growth phases. Through this incentive, Malta Enterprise provides support to start-ups such as support for the procurement of tangible assets and support linked to crowdfunding.
- **Startup Advance:** The aim of this initiative is also to finance innovative small start-up undertakings through a maximum grant of EUR 100,000.
- **Cooperate for Growth:** Undertakings which are willing to establish new markets or introduce a new product are eligible for this scheme which grants up to EUR 200,000 over any period of three consecutive fiscal years.

Other Maltese government agencies provide public financing to support innovative projects, as described below.

- **MITA Innovation Hub:** MITA launched an accelerator programme called 'YouStartIT' in order to incentivise digital entrepreneurship. MITA provides a seed investment of EUR 30,000, consisting of a cash grant of EUR 20,000 and EUR 10,000 worth of direct support.
- **Seed investment scheme by MIMCOL:** The Malta Investment Management Company Limited ("MIMCOL") launched this scheme with the main aim to encourage private investors to invest in SMEs by offering tax credits to these investors.
- **Fusion:** The Malta Council for Science & Technology ("MCST") operates a funding programme supported through Malta Government funds. This scheme supports local research and innovation and enables researchers to commercialise their innovative ideas.

Public finance initiatives supporting innovative projects in Malta are also provided through EU funds.

- The **SME Growth Grant Scheme** is a funding scheme targeted towards SMEs and is co-financed by the European Union (80%) and national funds (20%). Eligible SMEs who wish to expand their business may receive a non-repayable grant of up to EUR 500,000 to assist towards the implementation of their growth strategies.
- **Horizon 2020:** This is an EU initiative in order to encourage Research and Innovation through a reimbursement of eligible costs incurred in the project.

Under Operational Programme I for Malta's EU Cohesion Policy programme for 2014-2020, EUR 51m have been earmarked for European Regional Development Fund ("ERDF") grant schemes. As described below, various grant schemes were developed to support SMEs within the Information and Communications Technology (ICT) sector and to enhance SME competitiveness. These take the form of a grant, part- financing incurred expenditure.

- **e-Commerce grant scheme:** This grant scheme, capped at EUR 5,000, supports SMEs to invest towards the development or improvement of an e-commerce website or mobile application.
- **Other grants:** Other ERDF grant schemes include assistance to start-ups established for less than three years, supporting investment in tangible and intangible assets, and grants to support SMEs aiming to increase their national and international market presence.

Sources of private sector finance for innovation projects

Assistance to SMEs - Bank of Valletta ("BOV") successfully developed the BOV Joint Assistance Initiative for Maltese Enterprises ("JAIME") Financing Package with the aim to support SMEs to grow and expand further. SMEs are offered up to EUR 500,000²¹ in debt, for their projects. This financing is given to SMEs for capital investment and related working capital at advantageous interest rates and reduced collateral obligations.

Assistance to start-ups - The PwC EUR 1 million Start-up Fund: whereby EUR 1 million worth in pro bono services is granted to start-up companies in order to assist

²¹ "BOV JAIME Financing Package", Bank of Valletta, Accessed on 10th October 2018.

entrepreneurs in developing their business ideas and start their business on solid commercial footing.

The TAKEOFF Seed Fund Award ("TOSFA"), which was launched by UoM and the Ministry for the Economy, Investment and Small Business ("MEIB"), is in its fifth year. This award of EUR 100,000 aims at supporting researchers and entrepreneurs in achieving their innovative technologies and business ideas²².

GO p.l.c. announced that as at 2019, they will offer the finance scheme GO EUR 2 million Fund for Startups. The aim behind this is to offer financial support, telecommunication services, mentoring and physical space to start-up companies engaging in AI, Big Data, cybersecurity, fintech and other technology related lines of work.

Positive examples of initiatives undertaken by Malta

Some examples of successful projects under the MCST Fusion Program include but are not limited to:

Empowering SMEs with tools to help move to cloud computing – The objective of the project is to create a series of innovative tools which help SMEs transition their business to the cloud: 1) Without having to reinvent all their internal processes / reporting, and 2).

Whilst retaining the ability to push data in the cloud from familiar software such as existing spreadsheets. This can be achieved by creating a bridge between the data in the cloud and the local machine. Data is typically stored in a database or in a spreadsheet with the latter being the most problematic. The proposed project therefore addresses the latter scenario by providing an application, which connects the spreadsheet to the SaaS application and facilitates this exchange of information in a controlled environment. One of the primary target markets for this product would be the professional accounting practitioners, who invariably have practiced with spreadsheets for a significant part of their career. These tools need to be built using the same cloud principles to allow users to benefit from the related cloud- based advantages. This concept has already been successfully prototyped for the last 2 years. Results are very encouraging hence the proposal aims to expand, finalise and commercialise these tools. Scope have the necessary facilities to carry out this project including the office space and facilities.

Brain Controlled Applications – Brain Computer Interface (BCI) gives a person the ability to communicate with and control machines using brain signals instead of peripheral muscles. BCIs allow people with severely restricted mobility to control devices around them, increasing level of independence and improving quality of life. BCIs may also be used by healthy individuals, e.g. in gaming, and are expected to become a ubiquitous alternative means of communication and control. The project proposes the development of a novel application controlled directly with brain signals, opening up accessibility to individuals suffering from motor disabilities, and providing alternative access methods to healthy individuals. BCIs acquire the electrical brain activity using electroencephalography (EEG) electrodes, relying on brain phenomena such as those evoked by flickering visual stimuli, known as steady state visually evoked potentials (SSVEP). In the proposed system, stimuli are associated to commands, and EEG signals are processed to detect the intent associated to the brain pattern. A BCI challenge is to have BCIs operating in real environments amidst the

²² "TAKEOFF @ the Enterprise Campus", Centre for Entrepreneurship & Business Incubation, L-Università ta' Malta, Accessed on 8th October 2018.

nuisance signals generated by normal user actions. The project proposes solutions to this challenge, operating in real-time at the user's will. It also aims at addressing the annoyance factor of the flickering stimuli, ensuring that the system can be used comfortably for long periods of time, if necessary.

Touch Flight 2/ EPM –Pilots currently fly civil air transport aircraft primarily through direct interaction with the autopilot and flight management system (FMS), providing inputs via the flight control unit (FCU) on the cockpit glare shield or via the control and display units on the central pedestal. New technologies involving touch- screens are now being considered by the industry to reduce costs and pilot workload. Touch-Flight, a project funded by the 2012 R&I programme, developed a novel approach that focusses on bringing pilot- cockpit interaction to a single, line-replaceable tablet-like device. In this project, flight guidance and management functions were prototyped and evaluated successfully.

Touch-Flight 2 / ePM will build on the results of Touch-Flight, focussing on extending the original concept to now focus on multiple communication channels, including the Touch-Flight console, to further reduce pilot workload, thus contributing to increased operational safety and potentially act as a key enabler to reduced crew operations on board large transport category of aircraft. The project includes a prototype interactive Human Machine Interface which will be built and the concept developed within the project evaluated and demonstrated to industry.

2.2.10 Poland

2.2.10.1 Kuyavian-Pomeranian Region

Kuyavian-Pomeranian Voivodeship is a region situated in the mid-northern part of Poland. Its territory occupies an area of 17,972 sq km and its population is 2.08M people. Bydgoszcz and Torun are the main cities of the region, serving as its joint capital (governor's office is located in Bydgoszcz, while regional assembly seats in Torun). Bydgoszcz has 353,215 inhabitants, while Torun 202,495 inhabitants. Other region's major cities include Wloclawek (112,106), Grudziadz (95,781) and Innowroclaw (73,968).

Kuyavian-Pomeranian region's GDP amounted to 79.6bn PLN in 2015. GDP per capita is 38,190 PLN which is lower comparing to the national average of 46,792 PLN. The region is characterised by the high unemployment rate of 8.7 % (July 2018), comparing to the national average of 5.9 %. The average salary in Kuyavian-Pomeranian Voivodeship is 4170 PLN, comparing to 4800 PLN of a nation-wide significance. Investment outlays in the region's enterprise sector amounted to 3.8bn PLN in 2017.

According to Polish Agency for Enterprise Development the number of SMEs per 1000 inhabitants in the region is 43.43 (the best indicator belongs to Mazovian Voivodeship – 64.31, the worst – Podkarpacie Voivodeship – 35.97). According to the Agency, entrepreneurship indicator of the region is 58.46 placing in the middle of the ranking of Polish regions (maximal indicator in the country belongs to Mazovian Voivodeship and is 86.15, minimal to Warmian-Masurian, being 22,31). The number of newly registered SMEs in Kuyavian-Pomeranian Voivodeship in 2015 was 8.07 per 1000 inhabitants, which was lower than the average in the country of 9.17.

The main industry sectors, having largest R&D expenditures and biggest innovative growth potential, of Kuyavian-Pomeranian region include:

- **Electronics** – an electronics manufacturing complex have been developed in the sub-zone of Pomeranian Special Economic Zone laying in Kuyavian-Pomeranian Voivodeship. In frames of the complex numerous global electronics producers such as Sharp, Orion, Sumika Electronic Material, Kimoto and U-Tec have opened their manufacturing facilities.
- **Electro-mechanics** – the largest regional players include Polish largest manufacturer of trains and trams - PESA, one of the leaders of Polish electrical, measuring and mining equipment market - Apator or one of the biggest Polish suppliers of electro-technical equipment for shipbuilding and construction - Famor.
- **Chemicals** – there are multiple producers of chemicals in Kuyavian-Pomeranian Voivodeship, although most important players are Anwil (a daughter company of Polish fuel and energy giant Orlen) and Nitrochem, belonging to Polish Defence Holding (Polski Holding Obronny).
- **Food** – due to highly developed agricultural sector in the region, consumer goods occupy a significant part of the local industry. A French giant Bonduelle operates its manufacturing facility here, as well as a Dutch manufacturer of animal nutrition products Provimi has its experimental centre and central research laboratory in the region. If it comes to national players, one of the leaders of Polish food market Colian Holding has a confectionary manufacturing facility in Kuyavian-Pomeranian Voivodeship.
- **Paper production** – while only several companies operate in this sector, they have a significant share in the local economy, generating second largest revenues in the consumer goods sector and playing a key role in counties where they are located. Major companies are Mondi Świecie (Świecie) and International Paper - Zakład w Kwidzynie (Kwidzyn).

Kuyavian-Pomeranian region is home to more than 30 higher education institutions with over 60,000 students. The best university in the region, significantly contributing to the academic and research environment, is considered to be Nicolaus Copernicus University in Toruń, ranking 11th among best Polish higher education institutions. Nicolaus Copernicus University has 30,000 students alone, offering a broad range of majors such as biology, chemistry, earth science, medicine, pharmacy, mathematics and computer science as well law, economic sciences and business management.

The Pomeranian Special Economic Zone, operating in a part of Kuyavian-Pomeranian Voivodeship's territory provides income tax exemptions for enterprises in case if defined investment expenditures are incurred, or if a certain level of employment is reached. The minimum value of the investment expenditures in the Pomeranian Special Economic Zone is 100 000 EUR in the case of business activity conducted for a minimum period five years or three years for SMEs. Pomeranian Special Sub-Zone is located in Torun, encompassing an area of 2.6 ha. In the approximate vicinity of the city there are two more sub-zones – in Łysomice an area of 177.61 hectares and in Kowalewo Pomorskie with an area of 7.82 hectares.

Due to the presence of A1 highway, the region is well connected to the Baltic sea ports of Tri-City, as well as Lodz, Warsaw, Katowice and the Southern border of Poland. The region's international airport located in Bydgoszcz served 330,000 passengers in 2017. Kuyavian-Pomeranian Voivodeship is also well connected to the Baltic sea ports as well as major Polish cities via rail infrastructure.

The list of Regional Research and Innovation Strategies for Smart Specialisations consist of:

- **Healthy and safe food.** Food safety refers to the food supply chain, understood as a sequence of various stages and processes occurring in production, processing, distribution, storage, handling of food and its components, from primary production to final consumption.
- **Health and health tourism.** The specialisation is based on a strong scientific potential in the field of medical sciences of Kuyavian-Pomeranian Voivodeship and locally available resources, as well as experience and infrastructure in the field of sanatorium, hospital treatment, medical and rehabilitation services
- **Advanced materials and tools.** The specialisation in the field of production of tools and plastic products is based on a large number of SMEs specialising in the production of chemical components, tools for the production of plastic and metal products and the production of final plastic products. The field of producers of tools and plastic products gathers small and medium enterprises characterised by high flexibility and high competitiveness while production of raw materials is carried out by large chemical concerns with a wide product range and considerable production capacity.
- **Transport and mobility.** The specialisation aiming at radical development of economic functions related to the use of land and water transport routes (inland navigation), logistics, economic activities in the field of transport and trade. The specialisation is based on the untapped potential of the region connected with the value of the location and natural resources possessed in frames of logistics and transport purposes - waterways, as well as resulting from the shaped and developed system and infrastructure for land transport.
- **Cultural heritage and creative industries.** The basis for the development of this specialisation is a major resource base of the region, with a great potential for the development of innovative techniques and technologies in the area of design (industrial, utility, cultural) as well as creative industries (including computer games).

The majority of industrial and technology parks in Kuyavian-Pomeranian Voivodeship focus on the attraction of investors and providing them with the support necessary to start the operation in the region. Regional technology parks **playing a significant role in the development of entrepreneurship and innovation** are the following:

- **Grudziadz Industrial Park** – park with two industrial halls with a total usable area of 12k square meters, hosting Grudziadz Business Incubator. Business Incubator in Grudziadz, aiming at the support of micro and small enterprises is co-financed by the European Regional Development Fund and the Regional Operational Program of Kuyavian-Pomeranian Voivodeship.
- **Torun Industrial Park with the Technology Transfer Centre** – centre for the support of companies from the ICT industry, in which they can develop their potential and accelerate their growth. Torun Industrial Park creates an appropriate environment for innovative business projects. **Digital innovation hub IoT North Poland HuB, IoTNP**, participating in Smart Factories project operates within this park. The initiative promotes the usage of advanced ICT technologies in the manufacturing sector in order to create more innovative and competitive manufacturing SMEs and midcaps. One of the main objectives of DIH is increasing the awareness and competences needed to implement

prototypes and pilot lines in the area of the IoT in enterprises. At the current moment it serves as a leading community builder for IoT in Kuyavian-Pomeranian Voivodeship and beyond, actively developing IoT ecosystem in Northern Poland.

Main strength of the region are the following:

- High level of specialisation of the local economy, having a big potential for innovative development
- Well-developed entrepreneurship-supporting and innovation-driving infrastructure
- Proactive approach of the local authorities towards the main challenges through the creation of dedicated programs addressing those challenges

Main weaknesses of the region are the following:

- High unemployment rate
- Low level of entrepreneurship and dependency of the economy on large industrial players
- Intermediate level of academic and scientific base
- Unfavourable migration trends

Demand-side barriers regarding the implementation of digital transformation

Main demand-side barrier in Kuyavian-Pomeranian Voivodeship regarding digital transformation in the SME sector lays at the intersection of the lack of awareness about the transformation, the lack of need for it and the complicity connected with the transformation. The majority of SMEs in the region operate on a small regional scale, so the main reason for the lack of widespread digital technology systems among small and medium enterprises is a low level of need combined with a lack of financial capabilities to afford the purchase and integration of modern technologies. Only 65 % of the local SMEs have a webpage, and even less – 21 % are active in social media. The fact that only 2/3 of the enterprises are present in internet shows that the sector is not ready to dynamically transform into the highly digitalised one.

In order to address the issue further support regarding education in the area of technologies of SMEs decision makers and employees should be put in place, and the advantages of digitalisation should be communicated in a clear language of benefits.

Structural macro-economic barriers

The economic condition of Kuyavian-Pomeranian Voivodeship is relatively not favourable. One of the main structural economic problems of the Voivodeship is a low level of entrepreneurship. In 2016, only 197,1 thousand of small and medium enterprises were active in the region. Local economy's low capacity for job creation consequences into a permanently high unemployment rate in the region. The unemployment rates in the region's capital cities Torun (4.8 %) and Bydgoszcz (3.6 %) are better than the country's average of 5.9 %, while sub-region such as Grudziadz county (13 %), Wloclawek county (15.9 %), Lipno county (15.6 %) or Radziejow county (16.1 %) have critical indicators.

Additionally, the close location of some of the cities, playing a role of major Polish economic and industrial centres, creates a phenomenon known as the intellectual drainage. Educated professionals migrate from the Kuyavian-Pomeranian region seeking for the opportunities of employment, while situation on the native labour

market remains unfavourable, making them struggle to find employment. The demographic forecast for the Kuyavian-Pomeranian Voivodeship is not favourable, predicting further aging and diminution of the society. Another issue is the internal regional unevenness. According to Institute's for Market Economy Research evaluation, Bydgoszcz-Torun sub-region has the highest mark of economic attractiveness, while Wloclawek sub-region has a low mark and Grudziadz sub-region the lowest.

One of the main barriers regarding the implementation of digital transformation and innovative activity of the SMEs, distinguished for Kuyavian-Pomeranian Voivodeship is an unfavourable situation of the regional labour market. According to the report prepared by the Government of Kuyavian-Pomeranian Voivodeship, there is an identified problem of the maladjustment of the educational resources to the needs of local economy. Consequently, there is a visible lack of qualified employees with a technical or engineering profile, while there is an excess of the employees with non-technical education, which consequences into high unemployment rate among this category. According to the report, there is also observed an insufficient number of university professors with a technical or engineering profile, which may be a barrier for the extension of technical specialisations at local universities.

The Regional Operational Program for the years 2014-2020 acknowledges the main macro-economic challenges and addresses them through creation of dedicated programs aimed at decreasing the unemployment rates (183M EUR) as well as boosting sustainable and even development of all of the sub-regions (500M EUR). It has to be noted that since 2014, the regional authorities have undertaken a set of measures aiming to improve social-economic situation in the region and namely attract investors and develop innovative entrepreneurship. Besides available sources of financial funding, numerous local business support centres have been opened, science and technology parks infrastructure have been developed and the engagement of the local authorities have raised.

Sources of available public finance for innovation projects

The Regional Operational Program (ROP) for the years 2014-2020 of the Kuyavian-Pomeranian Voivodeship amounts to 9.5bn PLN, out of which 2.1bn PLN (23 %) is devoted for the support of small and medium enterprises. 430m EUR are allocated for the purposes of the enhancement of the innovativeness and competitiveness of local economy. There is a number of available mechanisms in frames of the ROP, such as preferential loans up to 100,000 PLN for small enterprises or loans for the R&D activity in the SMEs sector (200,000 – 2M PLN).

Under **the Operational Program Smart Growth** there are multiple support opportunities for the SME sector, such as loan instruments for the technological innovation (up to 70 % of the outlays), subsidy for the R&D works in the strategic for the economy areas (up to 80 % of costs, minimum 1m, maximum 4m). Program called "Fast Track" offers the enterprises support for the development of new products as well as their market implementation (1m PLN – 50M EUR, up to 90 % of the costs). Another available option is called "Vouchers for Innovation" offering support up to 800,000 PLN for the purchase of external R&D services.

On the country-wide level there are programs operated by **National Centre for Research and Development** of Poland, such as **IniTech** financially supporting the cooperation between enterprises and scientific institutions, aimed at the development of the innovative products or **BRIDGE** program supporting young enterprises in the commercialisation of developed innovations.

Polish Development Fund (PFR) – provides a profound support for the enterprises of all sizes as well as for the individuals. The scope of its activity includes financial support of innovative projects among the SMEs and startups.

Funding opportunities for SMEs are also available under the European Union's **Horizon 2020** program, strongly supporting strategic innovative projects as well as business-to-business and business-to-science cooperation.

Sources of private sector finance for innovation projects

Kuyavian-Pomeranian Voivodeship have several local private investment funds located in the capital cities of Torun and Bydgoszcz, supporting innovative ventures in frames of small and medium enterprises as well as startups.

- **PolBan** – a network of business angels, present on the market since 2003, supporting innovative ventures. The main office is located in Bydgoszcz, but a branch is also operating in Warsaw.
- **NEUkubator** – an institution, supporting innovative ventures in the area of medicine and healthcare through direct financial investments as well as mentoring and advisory services. Business incubator is operated by a large Polish pharmaceutical company Neuca.
- **Business Link** – a Polish-wide network of business incubators, also present in Torun, which, through the partnership with a major investment fund bValue provides financial support for the innovative ventures.

There is also bank financing available in the region, however the majority of small and medium enterprises are not willing to use this source of private financing due to frequently unfavourable financial situation or due to the high risk of the innovative ventures.

Positive and negative examples of initiatives undertaken in the region

One of the positive examples of an initiative undertaken in the region is the **Centre of Business Support in Torun**. Active since 2015 and operated by Torun municipality, the centre aims to support business and economic activity in the region. The centre provides comprehensive support for entrepreneurs and investors, ranging from registration of a company, recruitment of employees to obtainment of tax exemptions or relevant funding. Moreover, the Centre of Business Support in Torun provides the stakeholders with the statistical data, necessary for business purposes.

Bydgoszcz Agency of Regional Development is a success story from another region's capital city Bydgoszcz. The agency is a part of the regional strategy for the support of innovation and entrepreneurship, providing comprehensive support to the entrepreneurs and organising numerous business events. In addition, the Agency serves as an open data centre for businesses of all sizes.

The Interdisciplinary Centre for Modern Technologies in frames of Nicolaus Copernicus University co-financed with the European Union funds serves as one of the main regional drivers of the commercial-scientific research, being a platform for cooperation of academia and business world.

Nova Tracking is a prosperous Bydgoszcz-based startup, which can be listed as one of the region's successes. The venture, being supported by the European Union funds and Polish Agency for Enterprise Development, provides comprehensive digital transport, forwarding and logistics management platforms. In cooperation with Poznan School of Logistics startup launched first in Poland Transport&Logistics 4.0

laboratory aiming to educate university students on digital logistics. Additionally, Nova Tracking operates its own online educational platform, where employees from SMEs can raise their competencies in digital logistics. Considering all of the above, a startup plays an unusually important role in local and national digital ecosystem.

2.2.10.2 Silesia

Silesian Voivodeship is a highly industrial region located in the South of Poland. With a population of 4,559,164 (11.9 % of Poland's total population), and the area of 12 333.09 square kilometres (3.9 % of Poland's total area) it is the most densely populated region in Poland. The capital of Silesia Katowice is its main city. The population of Katowice is 312,201, together with its surroundings it creates the largest urban area in Poland, CEE and one of the largest in the EU (2,500,000 inhabitants) called Upper Silesian agglomeration. Other main cities include Czestochowa with 235,798 inhabitants, Sosnowiec with 214,488 inhabitants, Gliwice with 186,346 inhabitants, Bytom with 176,106 inhabitants, Bielsko-Biala with 174,370 inhabitants and other.

Silesia is a major industrial centre of Poland, specialising mainly in coal, steel, energy, automotive, machinery and chemical sectors, generating the GDP of 229bn PLN, that amounts to 12.4 % of the national Gross Domestic Product. GDP per capita in Silesia is 3 % higher than the average in the country (50,172 PLN). However, the GDP growth is slightly slower than averagely among the regions. In 2016 Silesian GDP grew 2.8 % while the average significative in the country was 3.3 %.

The Silesian Voivodeship is rich in natural resources such as hard coal, zinc, lead, methane, natural gas, marlstone, chalkstone, as well as medicinal, thermal and mineral waters. The share of market and non-market services accounts for over 56 % and industry almost 35 %, ranking Silesia first in Poland. The regional industry shows a decreased share of mining and metallurgy in the recent years, that used to be predominant in the economy of the Voivodeship, and an increased share of the electro-engineering industry, the information technology industry, power industry as well as the automotive industry and food industry, that show the most rapid growth.

Unemployment rate in the Silesian region is 4.5 % (Katowice Statistical Office, July 2018), which is a better indicator than average for the country (5.9 %). The average salary in the region is 4884 PLN, which almost amounts to the national average of 4800 PLN.

Silesian transport infrastructure is one of the best in the country. Laying in a range of 600 kilometres from a number of European capitals, such as Warsaw, Berlin, Prague and Bratislava the region is intersected by two major transport corridors: highway A1 (a part of the European route E75, running all the way from Norway to Greece, in Poland from Gdansk to the Polish-Czech border in Silesian Voivodeship) and highway A4 (running through the Southern part of Poland from the border with Germany to the border with Ukraine). Katowice airport is the 4th most important airport in Poland having served 3,8m passengers and 17,7 thousand tons of cargo in 2017. Railroad plays a special importance in the transport infrastructure of Silesia due to its strategic location and hard industry giants located in the region. The share of the Silesian Voivodeship in Poland's railway transportation is around 50 %.

According to Regional Intelligent Specialisations Silesian Voivodeship prioritises the following areas in frames of its Development Strategy for the years 2014-2020:

- **Medicine.** High level of healthcare development is one of the factors differentiating Silesia from the majority of other regions. Therefore medicine was chosen as one of the priority specialisations of the region where further innovation-driven progress can be made. Development of biotechnologies as well as medical engineering are among top priorities in this sphere.
- **Energy.** Being an extremely important part of Polish economy and local Silesian economy in particular was chosen as one of the priority directions in the current region's development strategy. Main emphasis is being put on ecologic and efficient energy technologies.
- **Information and communication technology.** Acknowledging extremely high level of the ICT technologies importance in the general development of all social-economic spheres, information and communication sector was chosen among region's smart specialisations. Among the areas of specific importance there are Industry 4.0, telecommunications technologies and information security.
- **Green economy.** Due to the fact that Silesia is a highly industrial area, with a poor state of ecology, development of local green economy was chosen as the region's priority. This specialisation includes the whole variety of factors, although the key ones are the following: green construction technologies, ecological waste management, carbon emissions reduction and green industrial technologies.
- **Emerging industries.** With a high level of Silesian industrial development and willing to contribute for its further development the support of innovative industries was chosen as one of the region's priorities. Main sectors under this definition include industrial eco technology, space, mobile, mobile healthcare as well as maritime industries.

Katowice Special Economic Zone is a 2614 ha investment area with over 300 active business entities, launched in 1996 and foreseen to be active until 2020. The SEZ, offering support for small, medium as well as large enterprises has attracted 31bn PLN in investments and has created over 70000 jobs. The SEZ provides tax incentives and export support for participating companies. The biggest investment cases include Opel, FCA (Fiat Chrysler Automobiles), NGK Ceramics as well as Capgemini, Sopra Steria from BPO/IT sector.

In addition, there are 3 science and technology parks in Silesia:

- **Science and technology park Euro Centrum** – focuses on developing energy efficient technologies and energy saving in buildings. It supports the development of innovative technologies by carrying out a series of research, consultancy, training and educational activities.
- **Science and technology park Technopark Gliwice** – the main activity of the park is a creation and promotion of innovative and advanced technology companies and transfer of innovative technologies from the Silesian University of Technology and R+D units to small and medium-sized enterprises.
- **Bielsk science and technology park** – a technology park focused on the aviation area and related innovations. It supports entrepreneurs and innovators who want to develop their technologies in a modern and favourable environment.

Digital innovation hub:

Silesia Competence Centre Industry 4.0 SCCI 4.0: initiative is aimed at delivering support to the enterprises at different stages of the digital transition process by providing services and implementing dedicated projects, in order to strengthen the competitiveness of industrial SMEs and increase their role in international value chains. DIH is still under development at the current moment, although by the year 2022 it is foreseen to be a well-known, trusted and successful partner of at least 1000 industrial SMEs in Central Europe.

In order to address the main barriers for the digitalisation of SMEs in Silesia, which include lack of awareness among the SMEs of the impact of IoT on their production processes and business models, fear to engage in costly and risky investment projects as well as lack of necessary skills among the SMEs decision makers, DIH is building its business model relying on a close partnership with Silesian University of Technology, technology suppliers as well as large companies in order to provide at most integrated support for the SMEs, addressing all of their fears. The support includes demonstration and testing of technologies, virtualisation of production processes, feasibility analyses of proposed change scenarios, advice and training for personnel, investment project preparations, mediation between SMEs and potential technology suppliers, follow-up and mentoring.

A number of events dedicated to innovation and entrepreneurship take place in Katowice. Sample events include:

- **European Start-up Days** – an event based on presentations of the most innovative products of the Polish economy and networking of startups with corporations.
- **International Invention and Innovation Show** – INTARG show is a tool of market-oriented promotion of innovative products, technologies and services with Technology Readiness Level (TRL) between 4 and 9, as well as innovations which already entered the market and commercialisation of which already begun.
- **New Industry Expo** – three-day meeting under the sign of Industry 4.0 combining the advantages of the conference with strategic business debates, politicians and experts with the advantages of trade fairs and presentations and workshop meetings.
- **European Economic Congress** – a three-day series of debates, meetings and accompanying events with guests from Poland and abroad. The idea of the Congress is to integrate European entrepreneurs, to build awareness of community values among them and to outline the direction of Europe's activities. The subject of the EEC covers the most important issues for the economic and social development of Europe.

Strengths of Silesian Voivodeship include:

- Strong industrialisation, with emphasis on both industry and IT
- Well-developed transport infrastructure
- Strong academic base
- High GDP per capita
- A big number of innovation driving events
- Large potential for transformation

Weaknesses of Silesian Voivodeship are the following:

- Disproportion of the current state and potential of the sub-regions
- A significant share of outdated industry sectors
- Negative migration of qualified specialists
- Not sufficiently developed base for knowledge sharing and business-science cooperation

Demand-side barriers regarding the implementation of digital transformation

The majority of Silesian SMEs see a financial cost of any innovative or digital transformations as a structural barrier for the implementation of changes. Taking a loan for the purposes of innovation is seen among the entrepreneurs as too risky, considering the high level of risk of success and financial return on the innovative investment, which undermines the capability to return the taken loan.

Another important issue is lack of the sufficient demand for the innovative products or services on the internal market, which is not mature enough to absorb a big number of new, usually more expensive products.

Lack of awareness of the business owners concerning digital and innovative transformation is another major factor. This is shown by the unfilled recruitment of applications for co-financing of the projects by the European Union funds. The enterprises are not willing to compete for the funding opportunities for the innovative purposes as they do not foresee the innovation as a strategic area of the company's operation or they simply consider innovative and R&D works as an activity for larger players, not themselves.

Structural macro-economic barriers

Due to the Silesian richness in natural resources, its local economy had been built based on developing hard coal mining, iron and non-ferrous metallurgy, and machine industry. No emphasis on the development of digital technologies had been made. At the current moment the above sector has outdated capacities and generates pollution of the natural environment. Coal mining is decreasing as well as employment in the sector, which either creates unemployment or demands a costly national government interference in the form of subsidising. The main challenge of the region is the transformation of the outdated economic model to the technological, innovation-based entrepreneurial economy.

Another viable issue, encumbering the digital transformation of the local economy, is a demographic situation. The negative migration of valuable employees can be observed in Silesia. Although there is big number of universities situated in the region, a significant part of graduates, especially most prospective ones, migrate to Poland's capital Warsaw or abroad to seek of higher salaries or bigger opportunities, leaving the local Silesian market with a lack of valuable human resources necessary to successfully perform a digital transformation of the economy. Even with regard to the above, average outlays for R&D activity in the region are on the level of 0.62% of the GDP, while the national significative is 0.87%.

High level of differentiation if it comes to unemployment serves as the evidence of the geographical unevenness present in the region. The unemployment rate in Katowice is 2 %, while some areas have a close to critical unemployment rate. For example, Bytom county's unemployment rate reaches almost 10 %.

Sources of available public finance for innovation projects

Several sources of public funding are available in Silesian Voivodeship. The European Union funds remain the main source of public financing for SMEs. Small and medium enterprises can apply among others for a subsidy up to 500,000 PLN (reimbursement of the incurred outlays up to 50 %) for the purposes of implementation of information and communication technologies having a positive impact on functioning of an enterprise under **Silesian Operational Program** for the years 2014-2020.

Funds for SMEs are also available through the **Smart Growth Operational Program**, focusing on innovation and R&D. The options under this programme include loans for the development of technological innovation within the enterprise (up to 70 % of the incurred outlays), subsidies in frames of the "Fast Track" ("Szybka ścieżka") program for the R&D works (up to 20m EUR, 80 % of incurred investment outlays) as well as product pre-implementation works (up to 200,000 EUR, 90 % of incurred investment outlays), "Vouchers for innovation" meaning additional funding for innovation or technological improvements when using services of external research institutions (up to 800,000 PLN), subsidies ranging up to 1,5m PLN for the improvement of products as well as other programs with a similar emphasis on the development of innovative products or elements of the organisation's structure.

Loan fund „Śląski Fundusz Pożyczkowy" (Silesian Loan Fund, managed by Fundusz Górnośląski S.A. w Katowicach), co-financed by the EU provides preferential loans for SMEs among others for the investment purposes in the area of implementation of technological solutions and software. The loans with the interest rate of 1 % are limited to 1m PLN.

Local **Agency of the Regional Development** provides low interest rate investment-aimed loans for the SME sector. The amount of support is 10,000-250,000 PLN

In frames of **the Regional Operational Program** there is available funding for SMEs dedicated for the learning purposes. Enterprises are eligible to apply for an additional funding of max. 100,000 PLN (80 % of the costs) in order to improve the qualifications of employees or managing personnel.

Public sources funding available for startups from Silesia include a venture capital institution **PFR Ventures** operated by **Polish Development Fund**. PFR Ventures manages a set of investment funds supporting startups in a wide range of development stages, providing them with up to 60m PLN in investments.

Sources of private sector finance for innovation projects

Financing sources for SMEs in Silesia mainly include banks and in the meanwhile for startups - local venture capital funds or entrepreneurship supporting organisations.

ING Bank Śląski has a rich offer for the entrepreneurs, providing private loans in its own scope as well as in cooperation with public institutions. SMEs have the following options available: taking out a private investment loan from ING on a private basis, receiving a subsidy from the EU funds and covering own contribution with a loan or in case of a full reimbursement of the incurred costs after a completion of an investment ING finances the project and settles the payment directly with Polish National Development Bank (Bank Gospodarstwa Krajowego).

Additionally, there is a number of private financial companies operating on the Silesian market offering financial support in the form of loans for small and medium enterprises.

List of the main entities providing funding for innovative ventures from the Silesian region includes:

- **Business Link** – a nationwide network of business incubators, providing startups a wide range of services including financing through the cooperation with a reputable Polish venture capital fund bValue.
- **Impera Alfa** – a venture capital fund located in Katowice providing financial support amounting up to 1m. PLN to young innovative ventures. Part of the investment is contributed in return for a part of the shares in the startup and another part is being contributed as a non-reimbursable subsidy. Impera Alfa cooperates with scientific and research institutions as well as universities in the area of commercialisation of the scientific research. Additionally, the fund supports its client enterprises in their international expansion.
- **Yoshi** – named by Silesian Managers Association as Silesian company of the year in 2017, Yoshi serves as a platform, supporting innovative ventures, assisting larger companies in the search of startups and providing financing for both.

Positive and negative examples of initiatives undertaken in the region

Undeniable is fact that there is a number of positive initiatives undertaken in Silesia although the biggest success of the region, serving as its visit card in the Polish world of entrepreneurship and innovation is an annual event - **European Start-up Days**, taking place in Katowice accompanying another major event for the Central-Eastern European region - European Economic Congress. For the past three years the conference has been linking all of the stakeholders of the regional as well as national economy: entrepreneurs, decision makers of large corporate players, owners of small and medium enterprises, scientists and experts providing awareness on latest technological trends for some participants and generating leads for others. Moreover, the event serves as an important platform for education and knowledge sharing. Latest edition of European Startup Days gathered more than 2500 participants, 250 startups and 75 speakers. In addition to the whole event's framework, consisting of numerous debates, networking and marketing opportunities, as well as products exposition, a special startup competition has been launched. One hundred startups are being carefully selected and given a chance to take the floor for a pitch of the most influential representatives of Polish business world, and compete for a title of the best Polish startup. European Start-up Days is a revolutionary event having an impact on the local Silesian, as well as national Polish economy, promoting innovation among Polish businesses, boosting sales for entrepreneurs, educating both sides and serving as a platform for discussion, aiming to improve the legislative environment, but most importantly the event creates an entrepreneurial society and an entrepreneurial culture not only in Silesia but nationwide in Poland.

Another success if it comes to the promotion of entrepreneurship as well as innovative development of the SMEs is **Silesian Centre of Entrepreneurship**, serving as a one-stop shop for the enterprises seeking for the new opportunities in frames of business development.

Katowice Special Economic Zone has been an effective answer to region's economic problems, attracting foreign and national investments, generating specialised workplaces and most importantly boosting the innovation in the region.

2.2.10.3 Mazovia

Mazovia is the largest (35,5 thousand km²) and most populated (5,3m of inhabitants) region in Poland located in a geographic centre of the country. The biggest agglomeration of the region is Warsaw, other major cities include Radom, Płock and Siedlce. According to Polish Central Statistical Office, there are 792,333 SMEs registered in Mazovia, out of which 46,876 are active in the information and communication sector (32 % of the country-wide number). Regional unemployment rate in Mazovia is 5.1 % and is lower comparing to the country-wide significative of 5.9 %. Average monthly salary in Mazovia is higher than generally in the country (4800 PLN) amounting to 5750 PLN which is 12 % lower than EU 28 significative of 6530 PLN.

Mazovian region is characterised by the highest level of gross domestic product among other regions of the country (412bn PLN which amounts for 22 % of national GDP, Central Statistical Office 2016), broad workforce resources, both low-skilled as well as specialised in various fields, and presence of Warsaw Stock Exchange – financial centre of the Central European region with 472 companies listed (including 49 foreign) and total capitalisation of 1.23bn PLN. Warsaw is also a location chosen by 23 662 companies with foreign capital, which is nearly 44.4 % on the national scale. Mazovian outlays on R&D activities are one of the highest in the country. In the meantime higher than averagely in the country salaries typical for Mazovia consequence in higher labour costs for business.

Polish Agency of Enterprise Development ranked Mazovia as the most entrepreneur friendly region in Poland with an entrepreneurship indicator of 86,15 (max. 100). One of the main advantages of the region is its well-developed transport infrastructure as well as its attractive location at the intersection of major national and international routes, connecting the region with the major Polish and European cities via express highways. Warsaw Chopin airport is the main air gate of the country, serving more than 100 international commercial flights with 15.7M passengers and 84.4 thousand tons of cargo loads per year.

Mazovia possesses a strong academic and scientific research base with about 90 universities and colleges that account for 20 % of students in Poland, including a number of top Polish universities located in Warsaw. Among others, University of Warsaw and Warsaw University of Technology are ranked as respectively first and third best universities in Poland.

Regional Innovation Strategy of Smart Specialisation, prepared in order to support creation of the knowledge-based jobs in underdeveloped economic areas, lists the following sectors as priority for Mazovian region:

- **Food safety** – improving the quality and safety of food products, improving technologies and processes for the production, storage, distribution and utilisation of food and neutralising or reusing waste from agricultural and food processing.
- **Intelligent management systems** - technological solutions that enable optimisation and automation of production processes (including manufacturing technologies and Industry 4.0), infrastructure management as well as decision making.

- **Modern business services** - business support mechanisms, individually tailored services, availability of capital, infrastructure, and resources needed to grow innovative businesses.
- **High quality of life** - technological and organisational solutions used to provide social services, particularly in education, health, safety, work and leisure; actions aimed at stimulating social innovations, developing social capital and counteracting the negative effects of the developmental polarisation of the region.

The development of industry 4.0 technologies is crucially important for the support of the Regional Smart Specialisations, especially in the area of Intelligent Management Systems and Modern Business Services.

Mazovian sub-regions local business specialisations include:

- **Ostrołęka-Siedlce sub-region:** energy, paper, cellulose, wood, machinery, metal sector
- **Płock-Ciechanów sub-region:** printing, agri-food, electronics, petrochemical sector
- **Radom sub-region:** metalworking, telecommunications, footwear, armaments sectors
- **Warsaw Metropolitan Area:** R&D and technology transfer, business support services.

Mazovian region possesses a very well developed high-level business services infrastructure. In the area of technology and innovation development, there are 3 science and technology parks in Mazovian Voivodeship:

- **Science and Technology Park in Świerk** focuses on supporting SMEs, including startups whose value proposition is based on innovation and R&D, mainly in electronics, telecommunications, medical devices and security areas. Park offers its clients a wide range of spaces, including office and warehouse space, laboratories and conference halls. In addition, Science and Technology Park in Świerk provides consulting and research services for the innovative companies. At the current moment there are 6 companies operating in this park.
- **Mazovia Science and Technology Park** connects entrepreneurs, scientists and public authorities in order to implement joint projects and develop innovative solutions in biotechnology, renewable energy, agriculture as well as information and communication technologies. Park offers a wide range of services to its clients including consulting in the area of strategy planning, logistics, general management, human resources management, finance, legal, innovation, technology and product development.
- **Płock Industrial and Technological Park** is a joint venture of the city of Płock and the largest Polish fuel retailer Orlen, created with the aim to develop innovations in the area of chemicals and related branches. The park serves as an investment area with attractive conditions for the development of companies, providing its clients office space and technical infrastructure as well as business support services and financing from its member-investors. There are 18 enterprises currently operating in the park together with 10 companies present as investors.

Mazovian region with Warsaw in the lead possesses a vast infrastructure supporting innovation and development of startups. Below are listed some of sample initiatives positively influencing the area of innovations, startups, R&D and digitalisation:

- **Business Link** – a platform providing full cycle comprehensive support for young innovative businesses by playing a role of the connecting link between Academic Entrepreneurship Incubators, bValue investment fund as well as its own acceleration program.
- **Startup Hub** – is an organisation facilitating technological development in the CEE region. Startup Hub provides resources for entrepreneurs to develop their ideas or improve their products. In a partnership with investment funds it provides funding up to 1,7m EUR to its clients as well as a full business development program.
- **Academic Entrepreneurship Incubators** – a network of incubators present in numerous Polish cities supporting entrepreneurs on the earliest stages. Organisation provides office space, business and mentoring services for startups.
- **Campus Warsaw** – a coworking space that also provides a wide range of mentoring services as well as networking opportunities.
- **Centre of Innovation Management and Technology Transfer** – an academic innovation driving institution launched as part of Warsaw University of Technology. The centre provides valuable resources for the conduction of R&D works, commercialisation of research achievements and incubation of the innovative ventures. The centre brings together the academic, scientific and business worlds to develop and implement innovations in real life.
- **Centre of Entrepreneurship Smolna** – serves as a one-stop shop for the information relevant to business or innovation development. Besides that, the centre constantly organises educational and networking events.
- **Technology Relations Knowledge** – a platform organising numerous events dedicated to the development of entrepreneurship, innovation and promotion of implementation of technology solutions in enterprises.

In addition, Warsaw hosts numerous events in the field of innovation, such as:

- **Kongres Innowacyjnej Gospodarki (Congress of the Innovative Economy)** – a conference gathering more than 800 participants annually, serving as a debate platform for Polish beneficiaries of the pro-innovation activities.
- **Wolves Summit** – event specialising in providing networking opportunities for startups, aiming to the acquisition of investors and clients. Conference gathers entrepreneurs (startups), SMEs key decision makers, corporate leaders as well as investment funds representatives, providing them an opportunity to communicate, establish partnerships and even conclude deals.
- **Bitspiration** – one of the major startup conferences in Poland. The event is dedicated to startups and education of their founders.

Digital Innovation Hubs:

Digital Innovation Hub Świerk: DIH aiming to become a leading provider of innovation and research services for the companies from among others energy, nuclear and chemistry sectors willing to digitise their services. DIH supports them in:

IT maturity assessments, identification of goals/needs/opportunities and respective strategies for digital innovations, specialised research, enabling collaborative efforts, linking local, national and international initiatives. Specific services offered by DIH include: access to HPC & specialised laboratories (CyberLAB, climatic research, industrial tomography, electronic, cleanroom, metal printing); consulting by the team of twenty IT and IPR experts (computer simulations, industrial cybersecurity, GIS) as well as S&T Park services for start-ups. The hub have established partnerships with, among others, University of Warsaw, some of the largest Polish energy players such as ENEA, PSE or KGHM, enterprises from the SME sector and local authorities.

Automation and Robotics Hub (PIAP): digital innovation hub located in Warsaw, providing a complete support to SMEs in technological (advisory, engineering, research) and non-technological areas (business, legal, financial), along with testing and experimental facilities. DIH serves as a competence centre, a matchmaker and a network animator for SMEs looking for new solutions in the areas of digital manufacturing technologies and mobile robotics applications. The scope of functions performed by the hub includes: awareness creation, innovation scouting, digital maturity assessment, brokering and matchmaking, provision of access to specialist expertise and infrastructure, conduction of trainings, provision of access to funding opportunities and investor readiness services, collaborative research on issues of common interest.

Strengths of Mazovian Voivodeship include:

- Most prosperous economic situation and big potential for further growth
- Well-developed scientific and R&D units together with a strong academic base
- A profound ecosystem, largely due to Warsaw's role as an economic centre of Poland
- Attractive location

Weaknesses of Mazovia include:

- Low level of development of the sub-regions
- Low level of digitalisation of the economy
- Uneven development of the region

Demand-side barriers regarding the implementation of digital transformation

Even with a growing importance of digital technologies in the business sector and the EU Single Digital Market approaching, Polish SMEs seem to fall back with the development in this area. According to the survey conducted by Wroclaw University of Economics only 22 % of enterprises undertake intense activities in the area of digitalisation. Digital Economy and Society Index, measuring progress of EU countries towards a digital economy and society ranks Poland 24th out of 28 EU member states.

With a sufficient access to the relevantly specialised in the area of IT human capital and a big number of IT companies present in Mazovian region main reasons of the slow rate of digitalisation of the SME sector include unawareness of key decision makers of the enterprises about benefits of the business operation's digitalisation.

Aiming to increase the level of digitalisation of the SME sector further actions in the area of education of the business owners in regard to the implementation of digital solutions in their companies, as well as a greater number of platforms enabling

connecting and cooperation of SMEs and innovative ventures providing digital solutions should be put in place.

Other major reasons holding the SME sector back when it comes to digitalisation are costs and management complicity. The majority of enterprises does not have relevant resources to implement or even plan digital strategy. Moreover, digital transformation is often seen as simply unprofitable by SMEs decision makers. These are the barriers distinctive for any Polish region although the situation in Mazovia differs due to the highest number of SME in the country and therefore a strong competition on the local market, forcing the enterprises to look for the ways to distinguish themselves out of the competition and bring additional value to their customers.

A positive tendency can be observed on the Mazovian market as it leads in numbers of newly created enterprises (12,69 per 1000 inhabitants), which have a bigger openness for the construction of modern digital systems in frames of their operation. Having no need for a complicated reconstruction of the outdated existing systems, new companies are more likely to lean on the modern standards of doing business and from the very beginning build their enterprises on the digital basis.

Structural macro-economic barriers

Generally, Mazovia has better macro-economic indicators if comparing to other Polish regions, but one significant factor needs to be taken into consideration. Warsaw agglomeration is the main generator of Mazovian GDP in the overall count, due to its vast cluster of industry giants and financial institutions, while the remaining part of the region is mainly rural.

Mazovian region has a high level of social-economic disproportion, which is a main issue if it comes to the macro-economic background. As Warsaw is characterised by the lowest unemployment rate in Poland, Szydlowiec county also situated in the Mazovian, is in a very poor situation, having an unemployment rate of 23.4 %, which is one of the worst significatives in the whole country. GDP in a number of Mazovian sub-regions barely reaches the level of 60 % of the national average.

The above consequences into the relatively low number of innovating enterprises in the region. According to Community Innovation Survey (CIS) only 22.4 % of companies conduct innovation-related activity (lowest for the country is 14.8 %, highest – 23.7 %). The highest number of innovative companies belongs to pharmaceutical, chemical and technological equipment production sectors. The number of industrial enterprises that in the years 2014-2016 introduced marketing innovations out of which the majority are technology-related innovations was only 9.2 % ranking as 8th result on the national scale. The significative for service-providing enterprises is slightly better (12.5 %), ranking first among the remaining Polish regions.

The Strategy of Development of the Mazovian Voivodship until the year of 2030 sets up plans aiming to address the main regional challenges through the implementation of a set of steps, which include among others further active usage of the European Regional Development Fund for the support of innovation and R&D activity among SMEs, foreseeing 759m EUR for the support of enterprises in this area, allocation of 68,4m. EUR for the widespread of the fast internet in frames of the operational program Polska Cyfrowa (Digital Program), implementation of Regional Territorial Investments in the problematic sub-regions.

Sources of available public finance for innovation projects

There are several sources of available funding for the enterprises operating in the Mazovian region.

Under the **Regional Operational Program Of The Mazovian Voivodeship** for the years 2014-2020, there are 491,5m EUR foreseen for the development of entrepreneurship, innovation and R&D in the region. Support of the enterprises in conduction of R&D works, commercialisation of the R&D activity results and appliance of innovative solutions by the enterprises are of a major emphasis of the program. Another major focus of the program is supporting projects aiming to develop Regional Smart Specialisations.

Enterprises from Mazovian region are eligible to apply for the EU support under a range of the countrywide available programs such as **Operational Program Smart Growth**. Under this program enterprises are eligible to receive subsidies for conduction of R&D works, construction of R&D facilities or commercial implementation of the results of R&D works, as well as bank loans for implementation of innovative solutions.

Financial aid is also available from **National Centre for Research and Development of Poland, Polish Development Fund** or directly from the European Union under **Horizon 2020** program.

Startups can benefit, among others, from **Start in Poland** program, supporting entrepreneurs willing to start their startups in Poland. Program supports startups throughout all of the stages of development and assists them in the international expansion.

Sources of private sector finance for innovation projects

Warsaw is a financial centre of Poland and one of the most important financial centres of the Central Eastern Europe. Therefore there is a rich scope of private financial opportunities and growth opportunities for innovative ventures. Some of the main Polish venture capital funds are located in Warsaw. Those are among others the following:

- **Ainot** – VC fund with a portfolio of 26 investments, supporting startups in the earliest stages with financing amounting to 800,000 PLN.
- **Giza Polish Ventures** – venture fund with an investment portfolio consisting of 34 ventures, supporting early stage and growth faze startups with investments in the range of 500,000 – 12m PLN
- **Hedgehog Fund** – investment firm specialising in seed or late stage startups providing them with the capital of 1m PLN and more. Has so far invested in 13 ventures.
- **IQ Partners** – a reputable venture capital fund from Polish capital city Warsaw, investing in innovative, technological ventures from IT, internet, communications as well as e-commerce sectors.
- **MCI** – one of the major Central European investment funds located in Warsaw. MCI supports innovative ventures operating in the digital sector (digital media, ecommerce, marketplace, fintech, IoT, SaaS, cloud and entertainment), general development of the digital ecosystem as well as companies that having achieved a leading position in the traditional economy, have ambitions to climb to the European and global level through the processes of digitisation.

All of the investment funds provide supporting, consulting and mentoring services to the client ventures complimentary to the basic financing.

Positive and negative examples of initiatives undertaken in the region

Noa Tech – a revolutionary startup from Warsaw, leading Polish market of automated and digital solutions for retail. Through its products such as automated cashier machines, startup enables SMEs of the retail market to optimise the circuit of cash in frames of their operation, while reducing risks connected to transportation of cash and cashier fraud as well as minimise time needed for the service of cash and assure its clients next level customer experience. In addition, Noa Tech develops automated post machines for small and medium sized post operators bringing them an opportunity to compete with such market giants like inPost.

Przemysł 4.0 (Industry 4.0) – a conference, considered to be one of the biggest successes in the area of the promotion of digitalisation. The event takes place every year and brings together representatives from the SME sector, startups, technology companies and large corporate players, serving as a platform for the increase of awareness of solutions present on the market, benefits of their implementation in enterprises and even for the generation of leads.

Warsaw Technology Park is an example of a right but unsuccessful initiative undertaken in the region. Government's idea to create a science and technology park in Warsaw appeared in 2005. On the later stages a dedicated enterprise controlled by Warsaw authorities was established and the project was planned to receive funding from the European Union. Due to the lack of engagement of local authorities Warsaw Technology Park's project was desisted in 2009 and never came to live.

2.2.10.4 Lesser Poland

Lesser Poland region, also known as Malopolska Voivodeship is situated in the southern part of Poland. It has an area of 15,108 square kilometers and a population of 3.39M. Krakow with a population of 767.3 thousand, is the capital of the region and simultaneously one of the major Poland's historical, administrative and economic centres. The list of other important cities in Lesser Poland includes Tarnów (108 thousand inhabitants), Nowy Sącz (81 thousand inhabitants) and Oświęcim (38 thousand inhabitants).

Lesser Poland is a popular touristic destination due to its picturesque mountain surrounding and Krakow being a centre of historic sights. According to the report prepared by Lesser Poland Marshal's Office, 15.9M tourists visited the region in 2017, contributing to the local economy 13.5bn PLN.

GDP of the region is 148bn PLN, accounting for 8 % of the national GDP (2016) and recording a 4 % growth, while the national average growth was 3.3 %. Lesser Poland's GDP per capita is 43,897 which is a lower significative than the average for the country of 48,368. The unemployment rate in July 2018 was 4.8 % (5.9 % national average), with 71,000 of unemployed registered. The employment in the enterprise sector is 502,800, while the average monthly salary is 4670 PLN (national average is 4800 PLN). The region accounts for 5.5 % of Poland's export or 8.5bn EUR, ranking 6th among other regions.

The city of Krakow is perceived as a technological capital of Poland. Main specialisations of technological companies based in Krakow include beacons, Bluetooth Enabled Devices, B2B SaaS and computer games. Krakow is a globally recognised centre for shared services and business process outsourcing generating

the amount of 50 000 jobs for the local economy. Polish multinational software giant Comarch was founded in Krakow and has its headquarters there. The number of SMEs in the region is 370,000. Institute of Market Research ranked Lesser Poland 4th in its ranking of investment attractiveness of Polish regions. The following aspects were taken into consideration: transport accessibility, labour resources and costs, public security and local authorities engagement in the area of investment attractiveness.

Due to A4 highway coming across the region, Lesser Poland is well connected to Ukraine, Germany and further Western-European countries as well as some of the major Polish industrial cities: Katowice, Wroclaw and due to the connection with A1 highway in Katowice, with Lodz and ports of Tri-City. However, there is no express highway connecting Krakow with Polish capital Warsaw (such highway exists on the territory of Mazovian and Świętokrzyskie Voivodeships, but Lesser Poland Voivodeship has not taken any measures to improve its road infrastructure in Warsaw's direction). Moreover, road infrastructure in the Southern mountain part of Greater Poland is underdeveloped. Krakow Jan Paweł II Airport is the second busiest Polish airport, having served 46,264 commercial flights to 86 cities in 24 countries, with 5,8m passengers transported as well as 3800tt of cargo in 2017.

Krakow is a home to some of Polish best higher education institutions. Jagiellonian University and AGH University of Science and Technology are being ranked as respectively 2nd and 5th best Polish universities. In a general count, there is over 150,000 of students studying at nearly 30 universities based in Lesser Poland.

The Lesser Poland region within the framework of Regional Intelligent Specialisations (RIS) identified the areas of economy and science described below, which are being an emphasis of development in the 2014-2020 years perspective. Investments in such precisely defined areas allow for optimisation of activities for economic development and for better use of technical and financial resources. Lesser Poland RIS are:

- **Life Science.** This RIS includes two value chains that describe innovation development processes in biotechnology and life science. They define the strategic potential of the Lesser Poland region, including health and quality of life (products and technologies used in the prevention, diagnosis, treatment and rehabilitation of human and animal diseases) and bio-economy (intermediates and products used for the production of pharmaceuticals, cosmetics, food, materials and energy).
- **Sustainable Energy.** The specialisation in sustainable energy within the Lesser Poland region covers six areas: Intelligent networks and energy storage, clean technologies for processing and conversion of fossil fuels, energy efficiency, energy from waste and chemical energy carriers, Renewable energy sources and energy-efficient smart buildings and cities.
- **Information and communication technologies, including multimedia (ICT).** ICT specialisation relates in particular to all activities involving the production and use of telecommunications and IT equipment and related services, as well as the collection, processing, sharing of information in electronic form using digital techniques and all electronic communication tools. The specialisation covers different 15 areas, such as: medical engineering technologies, information technologies supporting the production of high-quality food, automation and robotisation of technological processes.

- **Chemistry.** This specialisation includes in particular programs aimed at the implementation of new chemical compound, materials and technologies, including solutions in the field of chemical engineering, in areas related to health protection; agriculture, agri-food industry, wood and pulp and paper industry; biological and environmental chemistry; power engineering; natural resources; waste management; materials for the needs of construction and transport; advanced materials and nanotechnologies; sensors.
- **Manufacture of metals and metal products (excluding machinery and equipment).** The production of metals and metal products includes mainly research and development of technologies for the production and shaping of materials based on metallic and ceramic materials, waste management, excavations and obtaining raw materials. The specialisation covers technologies from 5 areas: innovative pro-ecological construction solutions and components in machines, devices and means of transport, Innovative environmentally friendly technologies for reducing and managing waste, innovative technologies and industrial processes, materials with improved functional properties, acquisition and processing of raw materials.
- **Electrical engineering and machine industry.** This specialisation includes production with the highest innovative potential of electronic, optical, electrical and mechanical devices, as well as the production of vehicles, means of transport and their components. The specialisation covers technologies from 7 fields: medical engineering technologies, innovative technologies, processes and products of the agri-food and forest-wood sectors, sustainable energy, intelligent and energy-saving construction, innovative technologies and industrial processes, automation and robotics of technological processes, optoelectronic systems and materials, intelligent creative technologies.
- **Creative and leisure industries.** Creative and leisure industries are activities that have their source in individual creation and talents, having the potential to create wealth and jobs through the production and exploitation of intellectual property. The specialisation covers technologies from four areas: creative industries, graphic design and industrial design (design), computer games and software (Interactive Leisure Software) and leisure industry.

Digital innovation hubs:

Cybersec HUB: launched in Krakow, DIH is aimed to support the industry in secure digitalisation and cybersecurity capacity building. Cybersec HUB aims to apply the living labs model of co-operation between start-ups, multinationals and national industry leaders (utilities, critical infrastructure etc.) in order to connect users and suppliers and as a result incentivise industry to develop world-class and cutting-edge cybersecurity products and services. Additionally, DIH promotes the concept of cybersecurity among local enterprises through the conduction of education and trainings.

DIH was created to answer main challenges and wishes of local business community, and to become:

- One-stop-shop for enterprises
- Testbed for technologies
- Networking node for the ecosystem
- Education-industry bridge

Krakow Technology Park's Digital Innovation Hub (KTP DIH):

Krakow Technology Park (KTP) is a significant driver of the local economy and innovation, hosting 300 companies and managing a Special Economic Zone. KTP is an important part of Lesser Poland's business ecosystem, serving as a one-stop shop for the enterprises seeking the opportunities to develop and as a platform for collaboration of scientific, academic and business worlds. The range of support provided by KTP includes tax exemptions in frames of SEZ, technical facilities, training and advisory services for the SMEs, incubation and acceleration for startups. KTP operates one of the two Polish Living Labs. Since its launch the park has attracted 4,5b PLN in investments and has created 29,000 jobs.

Digital innovation hub launched in frames of Krakow Technology Park supports scale up research & development as well as specifically project implementations in the field of industry 4.0, games industry, ICT, smart city solutions and related. Having an access to the ecosystem of KTP, the hub is a provider of the most comprehensive range of digital services, inspiring and supporting enterprises to implement innovative digital solutions. Services provided include: LivingLab, Data Centre, MultiLab, equipment rental, office and conference spaces, business support and consulting.

Strength of Lesser Poland Voivodeship include:

- Well-developed technological cluster
- Dynamic GDP growth
- Strong academic base
- Low unemployment rate
- A large number of foreign companies
- A significant number of sources of public finance for innovative ventures

Lesser Poland's weaknesses:

- Underdeveloped road infrastructure
- Underdeveloped entrepreneurship supporting infrastructure, especially in the sphere of business-science cooperation
- Disproportions in the development of the sub-regions

Demand-side barriers regarding the implementation of digital transformation

The main issue if it comes to the digitalisation in the sector of SMEs is a psychological barrier. A lot of small and medium enterprises were founded in the 1990-ies, and the owners of the enterprises who in the majority of cases play the role of their decision makers, are of the age of 50-60 years at the current moment. Polish older generation can generally be characterised as less proficient if it comes to technologies, and business owners are not an exception. They are either sceptical about new technologies in the company or simply afraid to implement digital changes. They rely first and foremost on their experience of doing business without any of the modern technologies.

The presence of the support mechanism popularising the adaptation of new corporate technologies have had a positive influence on the digitalisation of the SME sector, overcoming the barrier related to the cost of installation of new hardware or software. However, according to the report prepared by Centre of Market Research and Analysis

for Lesser Poland's Marshal's Office, a big part of small and medium enterprises' decision makers are not aware of the funding opportunities available and even if they are aware and have interest in using the European Union funds for the implementation of technological novelties, the application documentation seems too complex and time-consuming for them. Consequently the application for the grant concerning the implementation of technologies is frequently pushed away by the enterprise's primary responsibilities, taking into consideration limited human resources.

Digitalisation is often perceived as an additional activity, but not as the tool to significantly improve the functioning of the enterprise and increase sales. A presence of the web page is frequently perceived as an attribute of the technological advancement among the Lesser Poland's SMEs, and the sector is structurally not mature for further dynamic digitalisation.

Structural macro-economic barriers

One of the macro-economic barriers includes geographic unevenness characteristic for the Lesser Poland Voivodeship. GDP per capita in the city of Krakow is 76,283 PLN, while some of the sub-regions struggle to gain even half of Krakow's significance. For example, Oświęcim sub-region's GDP per capita is 36,116 PLN, Tarnów sub-region's – 30,575 PLN, Nowy Targ sub-region's – 26,504 PLN. Even the sub-region identified as Krakow's suburban area has only 34,938 PLN per capita.

Lesser Poland has a relatively small purchasing power standard amounting to 62 % of the average PPS for the EU member states. In Poland, the value of the index exceeded the EU average only in the Mazovian Voivodeship (109 %). This relevantly low significance means that the local internal market has low capacity and a low level of attractiveness for the enterprises. Factor as the above has a two-way direction. It serves as barrier and a reason for the low motivation of the SME sector to build on technical and digital capacities. However, it also serves as a catalyst for the export orientation of the local enterprises seeking for the increase in sales volume, bringing the necessity for the improvements in products and services connected with sales.

Another macro-economic issue of the region is the observed deficit of a number of, mainly technical, labour resources. The list of deficit professions includes IT engineers and programmers, and therefore SMEs very frequently have difficulties finding relevant personnel to carry out technical and digital transformations within the company. Furthermore, salary expectations among IT professionals, and especially those highly qualified are often beyond the SMEs capabilities.

Sources of available public finance for innovation projects

Lesser Poland has one of the largest **Regional Operational Funds for the years 2014-2020** in Poland amounting to 2.87bn EUR. It is specifically emphasized on the development of the entrepreneurship as well as on the support of the innovation in the SME sector. Under the Operational Program for Lesser Poland there are numerous funding opportunities available for the SMEs. Enterprises can apply for a subsidy to increase competencies of the personnel with the aim to improve the functioning of the enterprise and increase its competitiveness. Another possibility available in frames of the ROP is "Vouchers for Innovation" program providing financing up to 90 % of the costs (maximum 100,000 PLN) for the usage of the services of an external scientific unit with the purpose to develop an innovative product. Additionally, the SMEs are eligible to apply for the support of innovation and R&D works available under the Regional Operational Program. This support ranges in the frame of

100,000-25,000,000 PLN (up to 70 % of the incurred outlays) and is aimed for any stage of the innovation development. Lesser Poland's OP also offers preferential loans (up to 1m PLN) for small and medium enterprises willing to develop their business through the implementation of the innovative solutions. The same loan program is available for startups in early stages of development, aiming to support the development of new enterprises creation in the region.

Another available source of public funding is the European Union's Smart Growth Operational Program, under which the enterprises are eligible to apply for the preferential loans for the purpose of implementation of technological innovations, covering up to 70 % of the incurred costs. Another available source is the "Fast Track" program, available to the SMEs who are eligible to apply for the subsidy of up to 80 % of the outlays in case of R&D works and up to 90 % in case of the pre-implementation works of the developed product. The minimal cost of the project has to be 1m PLN in order to be eligible for the "Fast Track" program, the total cost of the project cannot, however exceed 50M EUR. Among numerous funding opportunities available under the Smart Growth Program there is a subsidy for the R&D and development works ranging up to 90 % of the incurred costs.

In Lesser Poland innovative startups might apply for funding from the publicly financed investment funds such as e.g.:

- **INNOventure** - investment fund operated by Krakow Technology Park in the cooperation with Polish National Centre for Research and Development, which supports innovative ventures from a diverse range of origin. The fund is specialising in the commercialisation of results of scientific research brought by academics, entrepreneurs or engineers.
- **Innovation Nest** - funded by the National Capital Fund of Poland in frames of the Operational Program Innovative Economy. Fund focuses on innovative ventures developing B2B solutions. It operates its acceleration program, which includes an investment of 25,000 USD, as well as incubation program full of mentoring and advisory services for young companies.
- **Nomad Fund** – is an investment company founded by the National Capital Fund of Poland under Polish-Swiss Cooperation Program. Capitalisation of the fund is 40m PLN and its investment strategy includes a wide range of companies' profiles.

Sources of private sector finance for innovation projects

While public funding is specifically popular among the enterprises, startups in Lesser Poland also source private finances. The list of locally based venture capital firms includes:

- **Satus** – one of the major Krakow investment funds investing mainly in technological startups. In a partnership with Krakow Technology Park, Satus operates a dedicated seed fund, separately from its own venture capital fund.
- **Augere Fund** – a private venture capital fund operating in Krakow, partly financed by the European union funds. It mainly focuses on ICT, nanotechnologies, advanced engineering technologies as well as life sciences.

Positive and negative examples of initiatives undertaken in the region

A viable success in the area of entrepreneurship in Lesser Poland is the program "Malopolska – here an idea becomes a technology", launched by the Marshal's Office in 2013. The program aims to support the entrepreneurial community in the region

through the financial support of the dedicated events. Since 2013, more than 80 events with more than 80,000 participants have been organised.

An informative internet platform "Małopolska" operated by Marshal's Office should be specifically noted. The web page provides access to any of the primary information needed by the entrepreneurs. It serves as a great point of first contact for the SMEs willing to start the development or the implementation of innovative changes.

In the area of startups, one of the region's most notable successes is CallPage – a dynamically growing company that develops an innovative call back technology. CallPage was founded in 2015, has attracted investments from several most reputable Polish venture capital funds such as bValue or Krakow-based Innovation Nest, and participated in one of the best European acceleration programs Startup Wise Guys. At the current moment Call Page is present globally and is one of the fastest growing startups in Poland.

2.2.10.5 Pomerania

Pomerania is a region located on the shore of the Baltic Sea in northern Poland. The biggest cities in Pomerania include Gdańsk (which is also the biggest harbour of Poland), Gdynia (the third biggest harbour of Poland) and Słupsk. Gdańsk, Gdynia and the popular tourist destination Sopot form one big agglomeration known as a Tri-City. According to Polish Central Statistical Office, there were 272,446 SMEs in Pomerania in 2016.

Pomerania was ranked second in the Polish Agency for Enterprise Development's ranking of the most entrepreneur-friendly regions in Poland. According to the Polish Investment and Trade Agency Pomerania is ranked 113 on a list of the best business locations within the EU (all 275 regions were considered). One of the region's major advantage is its Gdańsk Harbour, where almost 40 % of all imported Chinese foreign goods are handled. Gdańsk Harbour is the second-largest Baltic harbour (after St. Petersburg). Because of its port, Pomerania has one of the largest export rates among the Polish regions.

Pomerania's is host to two out of the top 10 Universities in Poland, those being the Medical University of Gdansk and Gdansk University of Technology (GUT). GUT specialises in industry work and digitisation, where for example the Faculty of Electronics, Telecommunications and Informatics of GUT, has over 200 employees and 3,500 students, and is the biggest ICT graduate school in the north of Poland with over 500 Master graduates and 20 Ph.D. graduates completing their studies at the Faculty every year.

There are two science and technology parks in the Tri-City:

- Gdansk Science and Technology Park which is part of the investment offer of the Pomeranian Special Economic Zone Sp. z o.o. where entities from Pomerania can cooperate in fields such as social, economic, research & development and self-government. Currently, there are over 100 companies operating in the Park, mostly in the field of innovative ideas. The Park's activities that attract the most attention are biotechnology, IT and energetics.
- Pomeranian Science and Technology Park in Gdynia is the biggest park of its kind in Poland. The Park offers space for companies' premises, fully equipped laboratories and conference centres with exhibition and meeting rooms, prototyping rooms, recreation areas, trainings and counselling. The main focus areas of innovative development are automation & robotics, biotechnology,

computer science, electronics and telecommunication, environmental protection, as well as industrial design.

The region also hosts over a dozen innovation-driving institutions and facilities, including:

- Baltic Port of New Technologies – an innovative business project combining the process of revitalisation of the premises of the former Gdynia Shipyard and support for the development of entrepreneurship in Pomerania through connection of innovative technological ideas with production and services in the country and abroad.
- Constructors' Park that supports new development opportunities offering space for creators and construction engineers where they can develop the most technologically advanced projects.
- Starter Incubator which main focus is on increasing start-ups' chances for success by offering space, knowledge and networking opportunities.
- Clipster – place where young entrepreneurs can share and develop their business ideas in the system co-work and living. "Digital nomads" can stay in Clipster for three months after successfully passing three recruitment processes.
- Gdynia Business Incubator that aims to support the development of the SMEs sector, which plays a significant role in Pomeranian's economy. Centre's tasks are focused on the transfer of knowledge and technology between science and business.
- AIP Gdansk Business Incubator is one of the oldest (established in 2004) business environment institution in Poland that supports ambitious people in starting their companies and introducing them to the domestic and foreign markets. Annually, more than one hundred new business entities start their operations through the AIP Incubator.

Together with the biggest key ICT cluster Interizon (also located in Tri-City), the region offers a unique environment for cooperation.

According to the research conducted by Konrad-Adenauer-Stiftung and Gdansk Institute for Market Economics (*Instytut Badań nad Gospodarką Rynkową*) Pomerania has poor investment attractiveness for industry. However, its investment attractiveness for services is medium while attractiveness for high-tech companies is high. 8 % of Polish IT-companies have its headquarters here and Pomeranian SMEs on average have higher investment spending than average Polish SME.

Moreover, the Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that Polish SMEs, including Pomeranian's SMEs fall far behind EU-average with respect to innovation-collaboration and in-house innovations. Region companies also underperform in introducing innovative products and services to the market. DESI (2017) ranks Poland 23rd in EU: only 21% of enterprises use information e-sharing services (36 % in the EU) and only 5 % use cloud (13 % in the EU).

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. Pomeranian RIS are:

- **Off-shore, port and logistics technologies, aiming to make logistics in Pomeranian intermodal hubs more efficient.** The Ship Design and Research

Centre and the Port of Gdansk Authority are the leaders of the ISP 1 (Intelligent Specialisations of Pomerania). PKP Cargo, leader of Polish railway freight market, and PGE, the biggest company of Polish energy industry, are representatives of this RIS.

- **Interactive technologies in an information-saturated environment** is the ISP 2 lead by the ICT Pomeranian Cluster, aiming to create new innovative technologies in ICT. Flex, one of global leading providers of semiconductors from Singapore, which has its facilities in Tczew, is among representatives of this RIS
- **Eco-efficient technologies in the generation, transmission, distribution and consumption of energy and fuels, and in construction**, which goal is to create new solutions in prosumer energy production, smart grid distribution and creating new, more efficient materials which could be used in power storage systems. Among representatives of this RIS is ENERGA, the third-biggest Polish energy operator,
- **Medical technology related to lifestyle diseases**, which goal is to develop innovative solutions in medical prevention of lifestyle diseases. Among representatives of this RIS is Polpharma, one of the leaders of the Polish pharmaceutical industry.

Demand-side barriers regarding the implementation of digital transformation

One of the structural problems in Poland is its low level of enterprises' digitalisation. In Pomerania this problem is getting even worse. After excluding high-tech companies, most of Pomeranian SMEs seem to be unaware of possibilities offered by digitalisation.

The ratio of companies having broadband internet connection is lower than the national average. Despite this result, the ratio of enterprises with fast broadband Internet connection in Pomerania (download speed of at least 100 Mb/s) is the second highest in Poland. Research conducted in 2015 by the Ministry of Administration and Digitalisation showed that the ratio of companies using digital ERP systems is also lower than the Polish average.

In order to implement and develop digital transformation in the Pomerania Region, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for added-value creation and servitisation, attracting external and foreign funding to leverage investment risks.

The above is set as a business goal of 3Hub – Pomeranian Digital Innovation Hub (coordinated by the Institute of Fluid Flow Machinery Polish Academy of Sciences), which takes part in the Smart Factories in the new EU Member States project.

Structural macro-economic barriers

Pomerania has a low unemployment rate (5.1 %), which is one percentage point lower than national unemployment rate in Poland. Many employers struggle to find employees suiting their needs, which results in rising wages in the region.

Special Economic Zones which in other regions in Poland have been the catalyst for economic growth, are not very efficient in Pomerania. The biggest barrier for them is the lack of investment required for the zones to optimally operate.

The rise of labour cost in the western part of the region (Słupsk) is not as significant as rate of growth in the Tri-City area. This makes the Słupsk-area more attractive for industry. Unfortunately, infrastructural development of Słupsk is poor. Neither highway, nor express-class railway to Słupsk has been constructed yet, so produced goods do not have adequate transfer lanes from factory to customer. Infrastructural underdevelopment is a fundamental development barrier for the Pomeranian industry outside of the Tri-City.

Sources of available public finance for innovation projects

In the Pomerania region there are numerous co-financing opportunities supporting innovative initiatives, mostly coming from EU funds.

Enterprises ranging from startups, SMEs and large enterprises can apply for EU funding from the Regional Operational Program of the Pomeranian Voivodeship for 2014-2020. Through the Regional Operation Program there will be 1.9bn EUR distributed to entities of the Pomerania region from the European Regional Development Fund and European Social Fund. Almost 700 m EUR is allocated to fund:

- Innovative and R&D projects (including projects in the field of digitalisation, automation and robotics, industry 4.0, biotechnology)
- Strengthening of Pomerania enterprises
- Developing e-services, as well as activities that aim to increase energy efficiency and renewable energy use.

Moreover, entities from Pomerania can apply for national and EU-level funding. The most important national programs that support innovation and R&D projects (including projects in the field of digitalisation, automation and robotics, industry 4.0, biotechnology and other highly advanced, innovative areas) are Szybka Ścieżka (Fast Path) for SMEs and large enterprises and sectoral programs such as InnoNeuroPharm (pharmacy), GameINN (video games), INNOSTAL (steel production) or INNOShip (shipbuilding industry). At the European level, entities from Pomerania can receive funding from programs such as Horizon 2020.

In 2017 the Management of the Pomerania Voivodeship had already contracted 52 % of the budget of the EU programs for 2014-2020 which made Pomerania region the most effective region in Poland allocating EU funds.

Examples of EU funds invested in in the Pomeranian region:

- Grants for business start

21 projects were granted 60M PLN in the form of non-repayable subsidies and in so-called bridge support in the initial period of running a new business from the European Social Fund to create and ensure the sustainability of newly created microenterprises.

- Creation of modern laboratories in Pomerania Universities

Universities in Pomerania region granted 90M PLN for 6 projects focused on the development of laboratory infrastructure for specialist research and development projects.

- Improving the competitiveness of companies

103 projects worth 145M PLN were funded in order to:

- improve the competitiveness of companies through the introduction of new products or services
- increase the efficiency of the company's operation through the use of information and communication technologies or eco-effective actions.

Other public finance initiatives for innovative projects and entrepreneurs:

- Pomeranian Development Fund 2020+

Pomeranian Development Fund 2020+ results from the agreement between the Board of the Pomorskie Voivodeship and Bank Gospodarstwa Krajowego (BGK, national development bank) and is worth 408M PLN. The implementation of the project targets the launch of support for companies operating for the development of innovative activities, including scientific and research activities, and strengthening the competitiveness of Pomeranian entrepreneurs. The support will cover a wide range of financial products, including loans for innovators, capital entry, sureties, micro-loans, development loans and investment loans. BGK selects financial intermediaries who in turn offer the aforementioned support for entrepreneurs.

In 2016, Pomerania Development Agency signed a contract for co-financing the project called "Invest in Pomerania 2020", which is a regional non-profit initiative that helps investors, especially foreign, carry out investment projects in Pomerania. It serves as a "one-stop-shop" providing its support at every stage of the investment process. The program has completed 87 projects which created over 13,000 new jobs.

Sources of private sector finance for innovation projects

Pomerania region, especially the Tri-City is the start-up centre in northern Poland. Not surprisingly the financial private sector aiming to support the start-up ecosystem is strong and is still developing dynamically. The Pomeranian start-up ecosystem is well saturated by accelerators, capital funds and business angels. The most known capital funds operating in Pomerania are Alfabeat, Black Pearls VC, Business Angels Seedfund, Platinum Seed, and Taylor Economics that are supplemented by accelerators and incubators like Starter Incubator, Space3ac, Clipster, O4 and Invenity Foundation.

Moreover, there are many events aimed at supporting start-ups and innovation ecosystem organised in the Pomerania region. For example the largest InfoShare conference among Central and Eastern Europe is organised every year in Gdańsk. Other important events organised in Pomerania are inter alia:

- Venture Day Conference hosted annually in Gdansk by Starter
- Gdansk Business Week
- European Financial Congress
- IT Academic Day
- Bioinnovation International Summit.

Young entrepreneurs and start-ups can choose between the financial support provided by business angels and capital funds and so-called smart money, where, in addition to financial support, they also receive support in the area of know-how, work space or opportunities for cooperation with science and business.

Positive and negative examples of initiatives undertaken in the region

Pomeranian region is known for its high-tech companies. The biggest success-story there is the case of IVONA System. IVONA was founded in a dormitory. Their goal was to help blind people in using computers and mobile phones. Thus, they decided to create a voice synthesiser. The company failed to receive credit funding from banks, as banks were sceptical to support a start-up company. At this time there were no business angels to support the project. Despite this drawback, the company was able to build the product with little or no external funding and has become a leader of voice synthesisers. In 2013, Amazon bought the company and the founders have continued to develop text-to-speech for the global market leader. This case shows that niche innovative products can be developed even if there is no significant external funding behind them.

Another success-story worth mentioning is Flowair, company founded in 2003. It produces economic heating and ventilation for large-cubature buildings. Flowair collaborates with British Gas and Bosch in a research project Heat4U. Its goal is to create a central heating solution that will rationalise energy consumption. The project has received 10M EUR in funding from the European Commission and was a part of 7th Framework Programme in R&D.

SpaceForest is another case to be mentioned. The company produces microwave communication systems and their technology was implemented by Tesat SpaceCom – major supplier for the global satellite market. SpaceForest participates in the European Cooperation in Science and Technology Action that aims to produce automatically charging mobile devices. Another ambitious project under developed by SpaceForest is Suborbital Inexpensive Rockets, which will go up to 150 km to be completed before 2022.

However, alongside success stories there are also disappointments. Deep Ocean Technology is a company that plans on constructing underwater hotels. Despite receiving huge EU-funding (from the National Centre for Research and Development, and private investors), the company has not produced a viable product. Media report that company's most talented and brightest employees has left the company, which makes the company's position even more troublesome.

A very important ongoing initiative is the creation of Polish Port Community System (PCS) in which Gdynia and Gdańsk Harbours are taking part. PCS is an information exchange platform for freight companies and owners of transported goods. Such platforms are used by the world's major ports, incl. Gdańsk main competitors Rotterdam and Hamburg. The lack of PCS was a challenge for companies operating in Pomeranian harbours. Thus, companies decided to develop such a system. Simultaneously, the Polish Ministry of Marine Economy and Inland Navigation started working on a similar solution not taking into account any previous work carried out by private companies in this area.

2.2.11 Romania

2.2.11.1 Bucuresti Ilfov region

The Bucuresti-Ilfov region contains the capital city of Bucharest and the surrounding county of Ilfov. The total population in the region amounted to **2.5 million** people in 2017²³, largely concentrated in the capital city of Bucharest (2.1 million people).

²³ National Institute of Statistics

The region exhibited strong economic growth in the 2010-2015 period, with GDP/capita raising by an average of **7.2%** per year – from **EUR 12,654** in 2010 to **EUR 17,882** in 2015. Both the growth rate and the absolute value of the GDP/capita are the highest among analysed regions in Romania.²⁴

Region	Population ²⁵	GDP ²⁶ (EUR Millions)	GDP/capita ²⁷	GDP/capita average growth ²⁸
Bucuresti-Ilfov	2,535,798	EUR 44,497	EUR 17,882	7.2%
Centre (Brasov)	2,631,447	EUR 17,731	EUR 6,716	4.4%
North-West (Cluj)	2,833,298	EUR 18,373	EUR 6,469	5.0%
South-Est (Constanta)	2,841,720	EUR 17,139	EUR 5,932	5.4%
West (Timisoara)	2,005,512	EUR 15,174	EUR 7,502	3.7%

The Bucuresti-Ilfov region concentrates the vast majority of research institutes in the country and a large number of innovation support and transfer organisations.

Region	Research institutes ²⁹	Science technology parks ³⁰	Innovation and technology transfer institutions ³¹	Clusters ³²
Bucuresti-Ilfov	31	1	14	18
Centre (Brasov)	1	-	5	16
North-West (Cluj)	1	-	9	10
South-Est (Constanta)	2	-	2	9
West (Timisoara)	3	1	4	1
Other regions	6	2	9	18
Total in Romania	44	4	43	72

The **MINATECH-RO** science and technology park³³ was funded in 2004-05 and focuses on R&D for micro- and nano-technologies. It offers:

²⁴ PwC calculation based on National Institute of Statistics data

²⁵ National Institute of Statistics, data for the year 2018

²⁶ National Institute of Statistics, data for the year 2015, latest available

²⁷ National Institute of Statistics, data for the year 2015, latest available

²⁸ Average growth for the 2010-15 time period. Calculated after the data was translated from RON to EUR. The EUR/RON yearly average exchange rate reported by the Romanian National Bank was used.

²⁹ <http://www.research.gov.ro/ro/articol/4514/sistemul-de-cercetare-institute-na-ionale-de-cercetare-dezvoltare-in-coordonare#Prezentare>

³⁰ http://www.icpe.ro/performeri/files/Lista_Parcuri_Stiintifice_si_Tehnologice_Martie_2012.pdf

³¹ <http://www.research.gov.ro/ro/articol/4728/sistemul-de-cercetare-infrastructuri-de-cercetare-infrastructura-de-inovare-si-transfer-tehnologic-entitati-de-inovare-si-transfer-tehnologic>

³² <http://economie.gov.ro/aparat-propriu/politici-industriale>

³³ <http://www.minatech.ro/en/description.htm>

- Technological transfer: realisation of prototypes, demonstrators or experimental models; small scale/pilot production after realising the prototype
- Technological services, micro-physical characterization, simulation and computer aided design
- Learning/training by preparation of courses and stages (with practical training) in the microsystems, micro- and nanotechnologies and micro-engineering domains
- Assistance and consultancy activities for SMEs and small innovative enterprises: information in micro-engineering, microsystems, micro- and nanotechnologies, access to databases, documentation, etc.
- Facilitating the access of Romanian innovative SMEs to European networks and partnerships; dissemination of information (organising conferences, workshops, editing publications, etc.)

Of the 14 innovation and technology transfer institutions in the Bucuresti-Ilfov region, five list information technology as an area of expertise:

- The **ITA BINNOTECH** business and technology incubator³⁴ is active since 2006 as part of the Biology Research Institute in Bucharest. It targets SME start-ups younger than 3 years and offers:
 - Office space and related facilities such as communications and conferencing infrastructure
 - Consulting related to the identification and contracting of national and international funding sources
 - Services related to the identification of potential university and research partners

ITA BINNOTECH currently hosts 3 companies, out of which one has software development as core activity.

- The **CIT-TE ICPE** technology transfer centre³⁵ was funded in 2004 and is part of the Electrical Engineering Research Institute. The centre aims to disseminate knowledge in the areas of electrical engineering, IT&C and energy and offers:
 - Advertising services in the publications it handles and at the industry-specific events it organises
 - Research and consulting services for the design of feasibility studies and business plans
 - Research and development services in the area of Electrical Engineering
- The **TTIPMD-ISS** technology transfer centre, active as part of the Lasers, Plasma and Radiation Research Institute in Magurele, with a focus on space related technologies

³⁴ <http://www.incdsb.ro/structura-organisatorica/bucuresti/incubatorul-tehnologic-si-de-afaceri/>

³⁵ http://www.marketwatch.ro/articol/3232/Centrul_de_informare_tehnologica_targuri_si_expozitii_ICPE/

- The **CTTIM-INFLPR** technology, marketing and innovation transfer centre³⁶, active as part of the Lasers, Plasma and Radiation Research Institute in Magurele. The centre aims to:
 - Facilitate collaboration with other national and international research centres
 - Engage students in the scientific research activities performed by the research institute
 - Licence patents and transfer know-how to the relevant industries
- The **INMA-ITA** business and technology incubator³⁷, which aims to offer SMEs in the agriculture and food industries support in the form of:
 - Office space and related facilities such as communications and conferencing infrastructure
 - Licensing and use of patents owned by the incubator, as well as support for developing concepts and pilot projects
 - Personnel training

Of the 17 clusters in the Bucuresti-Ilfov region, six list technology as an area of expertise:

- The **ELINCLUS** cluster³⁸ comprises 73 SMEs active in the development of various electronic products and has a Silver rating from the ESCA
- The **MECHATREC** cluster³⁹ is active in the mechatronics space since 2010 and comprises 13 R&D units, 9 relevant authorities, 22 institutions and 100 industry representatives. The cluster has received a Bronze rating from the ESCA
- The **Smart Cluster Alliance Danube Cyber Security Alliance DACSA** cluster, with a Bronze rating from the ESCA
- The **CONTROL & IT**⁴⁰ cluster lists 13 members and is active in the automation and IT landscape. The cluster has received a Bronze rating from the ESCA
- The **IND-AGRO-POL**⁴¹ cluster comprises 100 members with diverse backgrounds (SMEs, professional associations, authorities, etc.) and focuses on developing technologies and technical equipment for the agriculture and food industry. The cluster has received a Silver rating from the ESCA
- The **START INOVARE**⁴² cluster is active since 2016 and lists 31 members. The cluster targets several areas such as energy, environment, IT or Smart Cities and has been awarded a Bronze rating from the ESCA

The Bucuresti-Ilfov region was host to approximately **9,800** IC&T companies at the end of 2016⁴³. After a decrease in the total number of companies between 2008-11, the number picked up again in 2012 and continued to grow until 2016 – an average growth rate of **6%** for the 2012-16 period.

³⁶ <http://www.inflpr.ro/ro/node/1313>

³⁷ <https://www.inma-ita.ro/>

³⁸ <http://elinclus.ro/despre-elinclus/>

³⁹ <http://www.clustermechatrec.ro/>

⁴⁰ <http://www.control-it.ro/>

⁴¹ <http://www.inma.ro/indagropol/>

⁴² <http://startinovare.ro/despre/despre-noi/>

⁴³ National Institute of Statistics

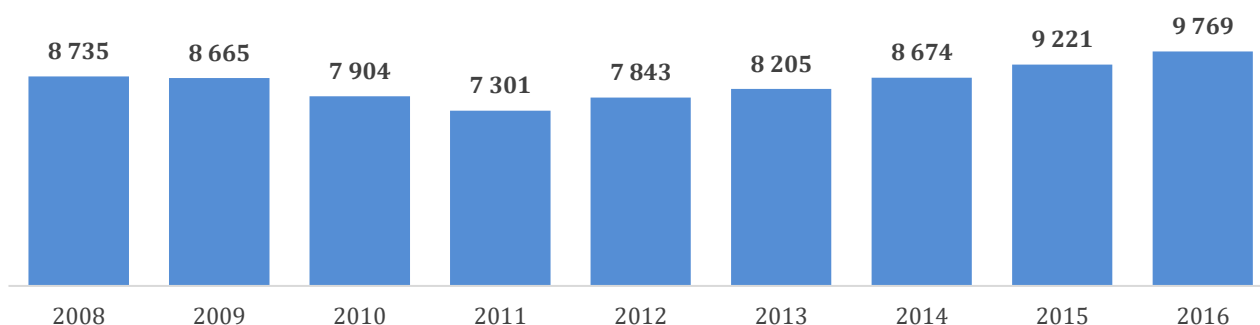


Figure 2: Number of IC&T companies – Bucuresti Ilfov region

A similar trend can be observed when analysing the evolution of the total revenue generated by the IC&T sector in the Bucuresti-Ilfov region⁴⁴ – after a significant drop between 2008-11, the industry has recovered and grew at an average **8.7%** a year in the 2012-16 period.

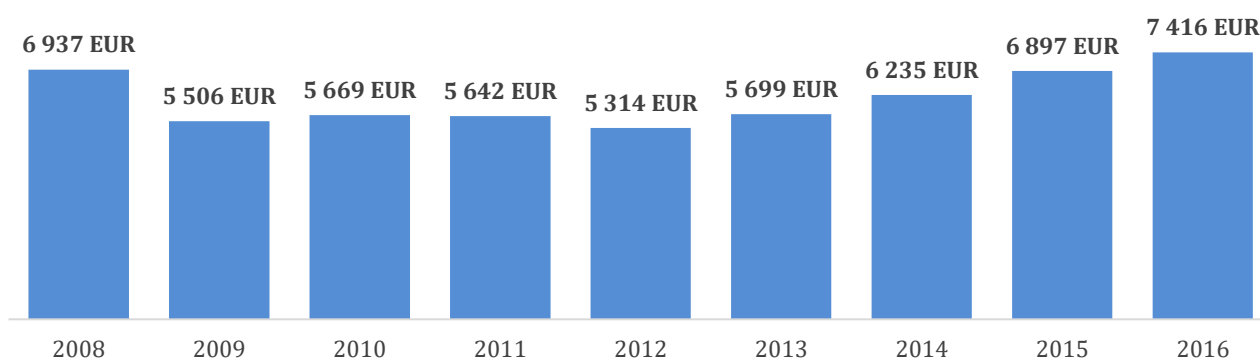


Figure 3: Total revenue of IC&T companies – Bucuresti Ilfov region, Euro millions

From a structural point of view, **90%** of IC&T companies are small, with less than 9 employees, and only **0.5%** large, with more than 250 employees. However, large companies generate approximately **60%** of total industry revenues.

Type of company	Total companies in 2016		2016 Revenues (EUR Millions)	
		% of total		% of total
0-9 employees	8,841	90.5%	EUR 778	10.5%
10-49 employees	703	7.2%	EUR 1,160	15.6%
50-249 employees	173	1.8%	EUR 1,045	14.1%
+250 employees	52	0.5%	EUR 4,432	59.8%
Total	9,769	100%	EUR 7,416	100%

Demand-side barriers regarding the implementation of digital transformation

⁴⁴ National Institute of Statistics

Romania ranks last in the Digital Economy and Society Index published by the European Commission⁴⁵. In the area of Integration of Digital Technology, which aims to quantify the digitisation of business and e-commerce, Romania's score is the lowest and 50% lower than the EU28 average.

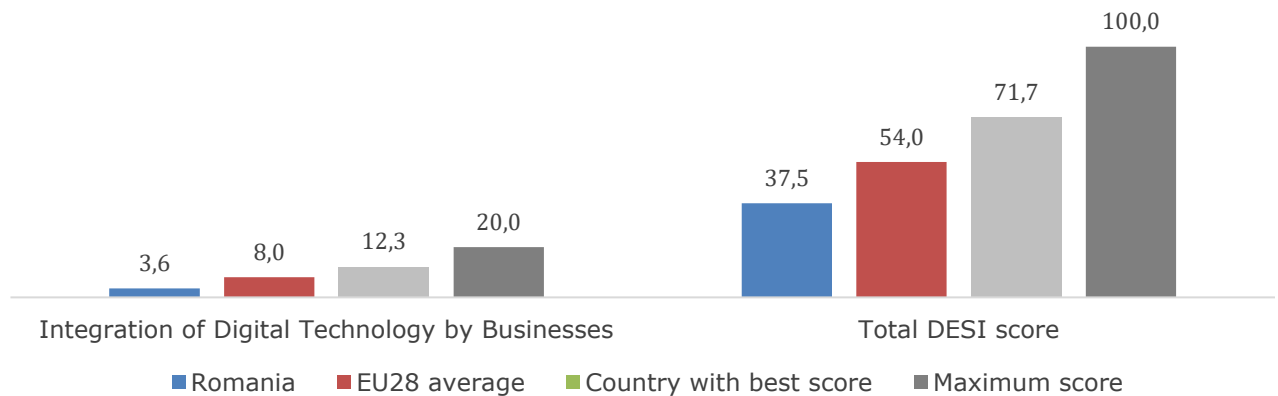


Figure 4: 2017 DESI score

Recent market surveys confirm that Romanian business leaders expect digitalisation to become a priority:

- According to the Connect Romania 2017 study⁴⁶ commissioned by Cisco, **90%** of IT respondents expect digitalisation to become a significant topic in the next 3 years – **48%** expecting digitalisation to have a big impact on their companies
- According to the 2018 CIO Survey⁴⁷ commissioned by Deloitte, Romanian CIOs believe digitalisation is a strategic priority, although they highlight that the concept lacks clarity and is interpreted differently among organisations

Structural macro-economic barriers

The continuous growth of the Romanian IT&C industry, coupled with the relative high cross-border mobility of trained IT&C personnel, has led to a significant deficiency of qualified IT staff. Competition for personnel resources has led to a decoupling of wages and labour productivity – wages for IT staff in the Bucuresti-Ilfov region have increased by an average of **6.9%** in the 2008-16 period, whereas revenue/employee has decreased by an average of **2%**.⁴⁸

⁴⁵ <https://ec.europa.eu/digital-single-market/en/desi>

⁴⁶ https://www.cisco.com/c/ro_ro/about/news/2017/171129.html

⁴⁷ <https://doingbusiness.ro/articol/deloitte-cio-survey-creste-interesul-pentru-tehnologii-emergente-in-romania-3944>

⁴⁸ PwC analysis based on National Institute of Statistics data

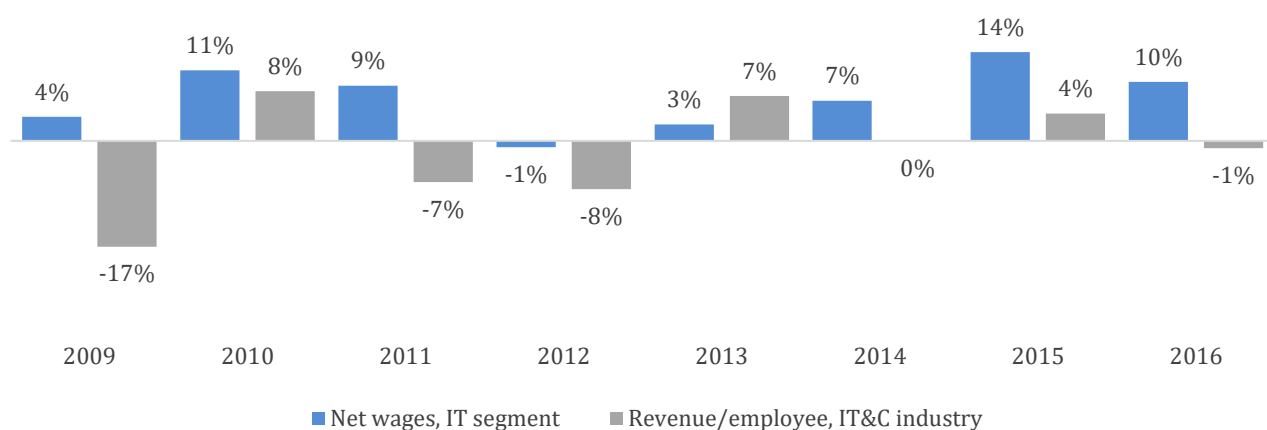


Figure 5: Year-on-year change in net wages and productivity –Bucuresti Ilfov region

The competition for IT&C personnel is also evident in the evolution of the job vacancy ratio⁴⁹, which has almost doubled from 2008 to 2017 in the Bucuresti-Ilfov region.

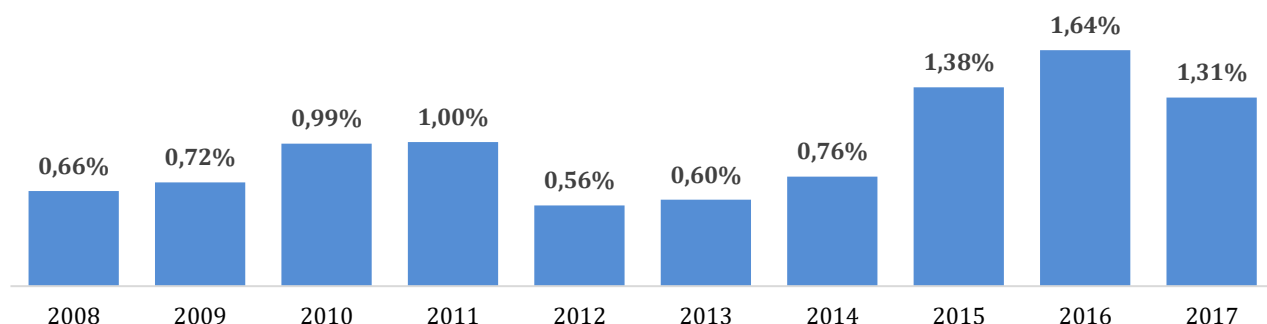


Figure 6: Job vacancy ratio – Bucuresti Ilfov region, IT&C companies

Interviews with IT&C business leaders⁵⁰ highlight that recent changes made by the Romanian government to the tax system negatively affect IT&C companies. Expected consequences of the changes include:

- Switching cash from investments to wages, in order to compensate the wage decrease resulted from the new taxation system
- Lowering the number of new hires
- Switching employees to alternative forms of employment

⁴⁹ The rate of job vacancies to total jobs, as measured by the National Institute of Statistics

⁵⁰ <https://startupcafe.ro/afaceri/anis-taxa-salarii-it-angajati.htm>

Sources of available public finance for innovation projects

The 2014-2020 Regional Development Strategy⁵¹ for the Bucuresti-Ilfov region identifies both the SME segment and R&D as fundamental pillars for the further development of the region. Relevant potential actions include:

- Further investment in the creation/upgrade of industrial parks and/or business incubators
- Financial support for start-ups
- Incentivising IT investments to improve business outcomes
- Incentivising investments in creative, innovative new products and services, particularly those with an IT component (e.g. e-commerce)
- Further support R&D, either directly or through the existing network of research institutions, partnerships, clusters, etc.

As part of the implementation phase, the 2014-2020 Regional Operational Program⁵² was designed to channel funding to the identified strategic issues. 12 funding axes were created, of which the first two are relevant to digital transformation initiatives:

1. Incentivise the transfer of technology
2. Increase competitiveness of SMEs

The Bucuresti-Ilfov region was not awarded funding on any of the two axes. Authorities have considered that the Bucuresti-Ilfov region is among the most developed in Romania and funding should be directed to less developed regions.

In addition to regional level funding, companies can also access national level funding. Alternatives include:

- The Competitiveness Operational Program⁵³, with two main axes:
 - Research, development and innovation to increase competitiveness – a total of **EUR 178 million** has been set aside for the Bucuresti-Ilfov region
 - Using IT&C to increase competitiveness – a total of **EUR 75 million** has been set aside for the Bucuresti-Ilfov region
- European grants⁵⁴
- Government subsidies/state aid⁵⁵

2.2.11.2 Centre region

The Centre region contains the Alba, Brasov, Covasna, Harghita, Mures and Sibiu counties. The total population in the region amounted to **2.6 million** people in 2018⁵⁶, with Brasov (0.63 million people) and Mures (0.59 million people) the largest counties.

The region exhibited strong economic growth in the 2010-2015 period, with GDP/capita raising by an average of **4.4%** per year – from **EUR 5,414** in 2010 to

⁵¹ <http://www.adrbi.ro/dezvoltare-regionala/consultare-pdr-2014-2020/pdr-bucuresti-ilfov-2014-2020-documente-finale/>

⁵² <http://2014-2020.adrbi.ro/prezentare/por-2014-2020/>

⁵³ <http://www.fonduri-ue.ro/poc-2014>

⁵⁴ <http://www.finantare.ro/calendar-granturi>

⁵⁵ <http://www.finantare.ro/granturi-subventii/catalog-subventii>

⁵⁶ National Institute of Statistics

EUR 6,716 in 2015. Despite the growth, GDP/capita remains significantly below that of the Bucuresti-Ilfov region – although largely on par with the rest of Romanian economic regions.⁵⁷

Region	Population ⁵⁸	GDP ⁵⁹ (EUR Millions)	GDP/capita ⁶⁰	GDP/capita average growth ⁶¹
Bucuresti-Ilfov	2,535,798	EUR 44,497	EUR 17,882	7.2%
Centre (Brasov)	2,631,447	EUR 17,731	EUR 6,716	4.4%
North-West (Cluj)	2,833,298	EUR 18,373	EUR 6,469	5.0%
South-Est (Constanta)	2,841,720	EUR 17,139	EUR 5,932	5.4%
West (Timisoara)	2,005,512	EUR 15,174	EUR 7,502	3.7%

The Centre region hosts an agricultural research institute and a fairly large number of technology transfer institutions and clusters, but lacks science and technology parks.

Region	Research institutes ⁶²	Science technology parks ⁶³	Innovation and technology transfer institutions ⁶⁴	Clusters ⁶⁵
Bucuresti-Ilfov	31	1	14	18
Centre (Brasov)	1	-	5	16
North-West (Cluj)	1	-	9	10
South-Est (Constanta)	2	-	2	9
West (Timisoara)	3	1	4	1
Other regions	6	2	9	18
Total in Romania	44	4	43	72

Of the 5 innovation and technology transfer institutions in the Centre region, two list information technology as an area of expertise:

- The **CIT ALBATECH** technology information centre is located in Alba Iulia, affiliated to the local Chamber of Commerce and focuses on IT and technology applications for the agro-food, environment and biotech sectors

⁵⁷ PwC calculation based on National Institute of Statistics data

⁵⁸ National Institute of Statistics, data for the year 2018

⁵⁹ National Institute of Statistics, data for the year 2015, latest available

⁶⁰ National Institute of Statistics, data for the year 2015, latest available

⁶¹ Average growth for the 2010-15 time period. Calculated after the data was translated from RON to EUR. The EUR/RON yearly average exchange rate reported by the Romanian National Bank was used.

⁶² <http://www.research.gov.ro/ro/articol/4514/sistemul-de-cercetare-institute-na-ionale-de-cercetare-dezvoltare-in-coordonare#Prezentare>

⁶³ http://www.icpe.ro/performeri/files/Lista_Parcuri_Stiintifice_si_Tehnologice_Martie_2012.pdf

⁶⁴ <http://www.research.gov.ro/ro/articol/4728/sistemul-de-cercetare-infrastructuri-de-cercetare-infrastructura-de-inovare-si-transfer-tehnologic-entitati-de-inovare-si-transfer-tehnologic>

⁶⁵ <http://economie.gov.ro/aparat-propriu/politici-industriale>

- The **CITT – I4T** innovation and technology transfer centre⁶⁶ is located in Brasov and offers a wide range of services, including:
 - Consulting services, with emphasis on R&D, AI, energy efficiency, and public administration projects such as smart cities
 - Support for start-ups in the form of financing (direct or through European funds) and training/consulting services
 - Technology development and testing services, particularly in the areas of e-learning, smart cities and IoT
 - Support for digitalisation projects, for example through the training and coaching of management decision makers

Of the 16 clusters in the Centre region, 2 list technology as an area of expertise:

- The **IT PLUS** cluster⁶⁷, located in Miercurea Ciuc, Harghita, comprises 46 members with a cumulated revenue of more than EUR 25 million and has a Bronze rating from the ESCA
- The **ALT BRASOV CLUSTER FOR INNOVATION AND TECHNOLOGY**⁶⁸, located in Brasov, comprises 35 members and has a Bronze rating from the ESCA

The Centre region was host to approximately **2,200** IC&T companies at the end of 2016⁶⁹. After a decrease in the total number of companies between 2008-11, the number picked up again in 2012 and continued to grow until 2016 – an average growth rate of **4%** for the 2012-16 period. However, the growth was not sufficient to reach the 2008 number of companies (2,212).

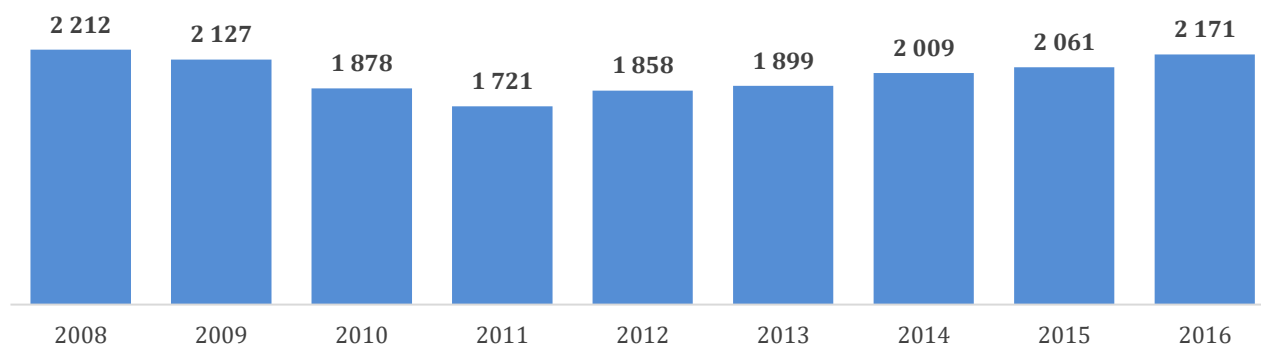


Figure 7: Number of IC&T companies – Centre region

A similar trend can be observed when analysing the evolution of the total revenue generated by the IC&T sector in the Centre region⁷⁰ – after a slight drop between 2008-11, the industry has recovered and grew at an average **2.1%** a year in the 2012-16 period (with the largest part of the growth from 2011 to 2012).

⁶⁶ <https://www.iceberg.ro/centrul-de-inovare-si-transfer-tehnologic-citt-i4t/>

⁶⁷ <http://www.itpluscluster.ro/ro/despre-cluster>

⁶⁸ http://www.altbrasov.eu/ro/#section_cine

⁶⁹ National Institute of Statistics

⁷⁰ National Institute of Statistics

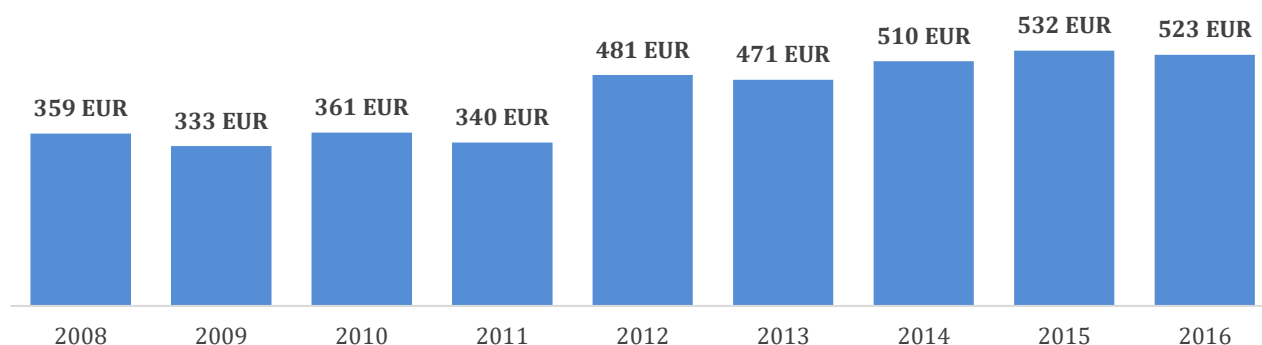


Figure 8: Total revenue of IC&T companies – Centre region, Euro millions

From a structural point of view, companies in the 50-249 employees segment dominate the Centre region. These amount to **2.2%** of the total number of companies and generate **46.5%** of total revenues. Medium sized companies in the 10-49 employees segment are also important revenue generators.

Type of company	Total companies in 2016	% of total	2016 Revenues	
			(EUR Millions)	% of total
0-9 employees	1,952	89.9%	100	19.2%
10-49 employees	170	7.8%	152	29.1%
50-249 employees	47	2.2%	243	46.5%
+250 employees	2	0.1%	27	5.2%
Total	2,171	100%	523	100%

Demand-side barriers regarding the implementation of digital transformation

Romania ranks last in the Digital Economy and Society Index published by the European Commission⁷¹. In the area of Integration of Digital Technology, which aims to quantify the digitisation of business and e-commerce, Romania's score is the lowest and 50% lower than the EU28 average.

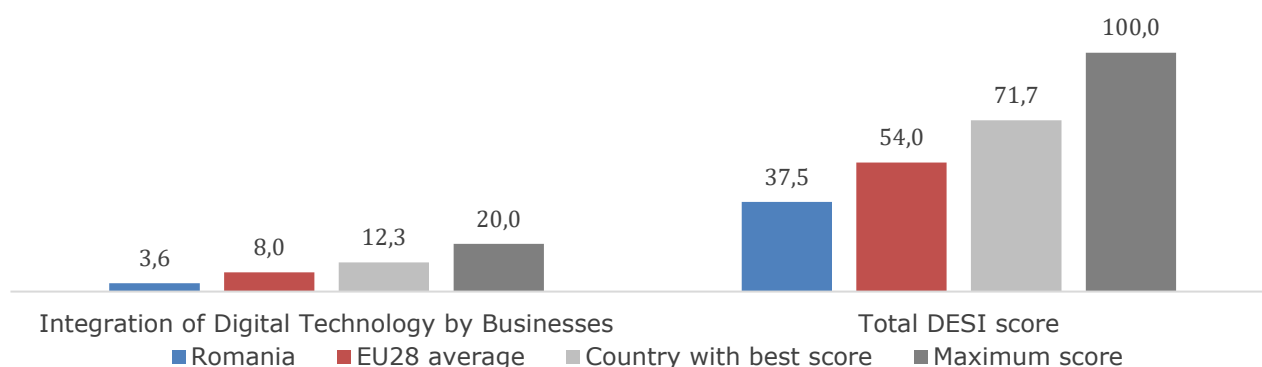


Figure 9: 2017 DESI score

⁷¹ <https://ec.europa.eu/digital-single-market/en/desi>

Recent market surveys confirm that Romanian business leaders expect digitalisation to become a priority:

- According to the Connect Romania 2017 study⁷² commissioned by Cisco, **90%** of IT respondents expect digitalisation to become a significant topic in the next 3 years – **48%** expecting digitalisation to have a big impact on their companies
- According to the 2018 CIO Survey⁷³ commissioned by Deloitte, Romanian CIOs believe digitalisation is a strategic priority, although they highlight that the concept lacks clarity and is interpreted differently among organisations

Structural macro-economic barriers

The continuous growth of the Romanian IT&C industry, coupled with the relative high cross-border mobility of trained IT&C personnel, has led to a significant deficiency of qualified IT staff. Competition for personnel resources has led to a decoupling of wages and labour productivity – wages for IT staff in the Centre region have increased by an average of **7%** in the 2008-16 period, whereas revenue/employee has decreased by an average of **4.6%**.⁷⁴

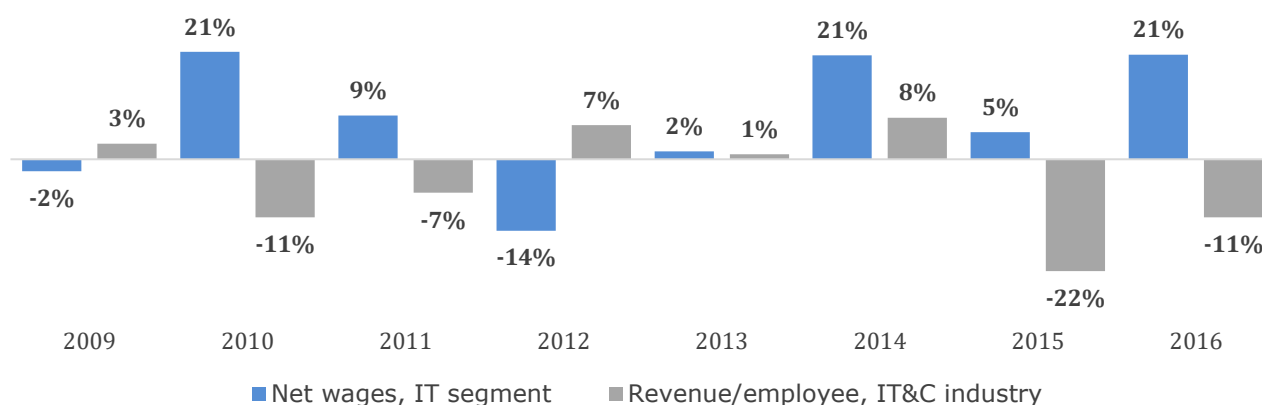


Figure 10: Year-on-year change in net wages and productivity – Centre region

The competition for IT&C personnel is also evident in the evolution of the job vacancy ratio⁷⁵, which has increased significantly since 2008 – despite dropping sharply in 2017.

⁷² https://www.cisco.com/c/ro_ro/about/news/2017/171129.html

⁷³ <https://doingbusiness.ro/articol/deloitte-cio-survey-creste-interesul-pentru-tehnologii-emergente-in-romania-3944>

⁷⁴ PwC analysis based on National Institute of Statistics data

⁷⁵ The rate of job vacancies to total jobs, as measured by the National Institute of Statistics

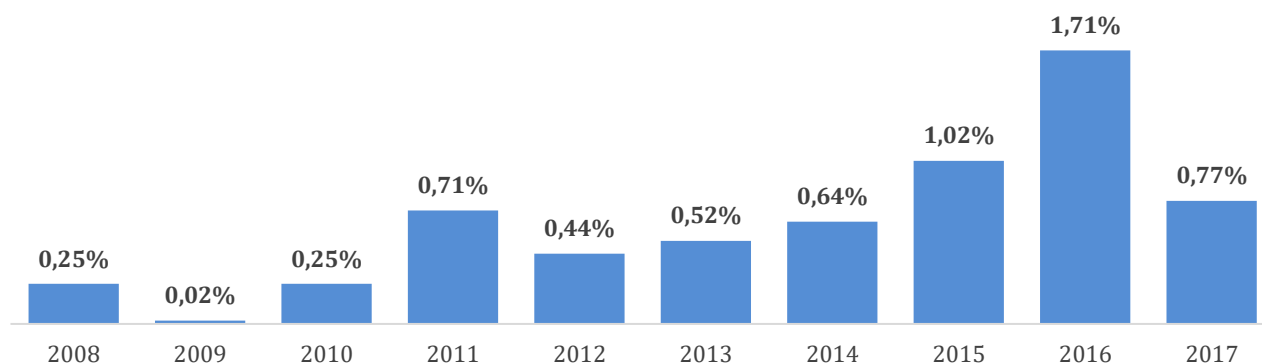


Figure 11: Job vacancy ratio – Centre region, IT&C companies

Interviews with IT&C business leaders⁷⁶ highlight that recent changes made by the Romanian government to the tax system negatively affect IT&C companies. Expected consequences of the changes include:

- Switching cash from investments to wages, in order to compensate the wage decrease resulted from the new taxation system
- Lowering the number of new hires
- Switching employees to alternative forms of employment

Sources of available public finance for innovation projects

The 2014-2020 Regional Development Strategy⁷⁷ for the Centre region identifies the need to increase competitiveness through research, development and innovation activities. Relevant potential actions include:

- Further investment in the creation/upgrade of industrial parks, business incubators, clusters and similar facilities
- Incentivising companies to use existing resources in a more efficient manner
- Modernising the existing R&D infrastructure

As part of the implementation phase, the 2014-2020 Regional Operational Program⁷⁸ was designed to channel funding to the identified strategic issues. 13 funding axes were created, of which the first two are relevant to digital transformation initiatives:

1. Incentivise research, development and innovation activities – a total of **EUR 194** million have been set aside for the Centre region
2. Increase competitiveness of SMEs – a total of **EUR 824** million have been set aside for the Centre region

In addition to regional level funding, companies can also access national level funding. Alternatives include:

- The Competitiveness Operational Program⁷⁹, with two main axes:

⁷⁶ <https://startupcafe.ro/afaceri/anis-taxa-salarii-it-angajati.htm>

⁷⁷ <http://www.adrcentru.ro/lista.aspx?t=adelabourare%20pdr%202014-2020>

⁷⁸ <http://regio-adrcentru.ro/1-consolidarea-cercetarii-dezvoltarii-tehnologice-si-a-inovarii/>

⁷⁹ <http://www.fonduri-ue.ro/poc-2014>

- Research, development and innovation to increase competitiveness – a total of **EUR 716 million** have been set aside for regions other than Bucuresti-Ilfov (including the Centre region)
- Using IT&C to increase competitiveness – a total of **EUR 555 million** have been set aside for regions other than Bucuresti-Ilfov (including the Centre region)
- European grants⁸⁰
- Government subsidies/state aid⁸¹

2.2.11.3 North West region

The North West region contains 6 counties: Bihor, Bistrita Nasaud, Cluj, Maramures, Satu Mare and Salaj. The total population in the region amounted to **2.8 million** people in 2018⁸², with Cluj (0.73 million people), Bihor (0.62 million people) and Maramures (0.52 million people) the largest counties.

The region exhibited strong economic growth in the 2010-2015 period, with GDP/capita raising by an average of **5.0%** per year – from **EUR 5,060** in 2010 to **EUR 6,469** in 2015. Despite the growth, GDP/capita remains significantly below that of the Bucuresti-Ilfov region – although largely on par with the rest of Romanian economic regions.⁸³

Region	Population ⁸⁴	GDP ⁸⁵ (EUR Millions)	GDP/capita ⁸⁶	GDP/capita average growth ⁸⁷
Bucuresti-Ilfov	2,535,798	EUR 44,497	EUR 17,882	7.2%
Centre (Brasov)	2,631,447	EUR 17,731	EUR 6,716	4.4%
North-West (Cluj)	2,833,298	EUR 18,373	EUR 6,469	5.0%
South-Est (Constanta)	2,841,720	EUR 17,139	EUR 5,932	5.4%
West (Timisoara)	2,005,512	EUR 15,174	EUR 7,502	3.7%

The North West region hosts a physics research institute and a fairly large number of technology transfer institutions and clusters, but lacks science and technology parks.

⁸⁰ <http://www.finantare.ro/calendar-granturi>

⁸¹ <http://www.finantare.ro/granturi-subventii/catalog-subventii>

⁸² National Institute of Statistics

⁸³ PwC calculation based on National Institute of Statistics data

⁸⁴ National Institute of Statistics, data for the year 2018

⁸⁵ National Institute of Statistics, data for the year 2015, latest available

⁸⁶ National Institute of Statistics, data for the year 2015, latest available

⁸⁷ Average growth for the 2010-15 time period. Calculated after the data was translated from RON to EUR. The EUR/RON yearly average exchange rate reported by the Romanian National Bank was used.

Region	Research institutes ⁸⁸	Science technology parks ⁸⁹	Innovation and technology transfer institutions ⁹⁰	and Clusters ⁹¹
Bucuresti-Ilfov	31	1	14	18
Centre (Brasov)	1	-	5	16
North-West (Cluj)	1	-	9	10
South-Est (Constanta)	2	-	2	9
West (Timisoara)	3	1	4	1
Other regions	6	2	9	18
Total in Romania	44	4	43	72

Of the 9 innovation and technology transfer institutions in the North West region, four list information technology as an area of expertise:

- The **CIT-UTCN-CUNBM** technology information centre⁹² is located in Baia Mare, affiliated to the Engineering University and focuses on transferring technical know-how to SMEs
- The **CTT IPA CIFATT** technology transfer centre⁹³ is located in Cluj and focuses on the following activities:
 - R&D in the areas of SCADA systems, dam monitoring/surveillance and eHealth
 - IT application training services
 - Technology transfer in the field of control, IT and electronic devices
 - Applications for automation and control systems (industry and environment)
- The **CTT IT** technology transfer centre⁹⁴ is located in Cluj and is part of the Centrul de Informatica Miniera company (which in turn is part of the Brinel system integrator). Recent projects supported by European funding (2007-13 timeframe) have focused on helping partners increase workforce qualification through training and certifications
- The **CTTC** technology transfer centre⁹⁵ is located in Cluj and is affiliated to the Technical University. It focuses on the following activities:
 - The marketing of intellectual property rights owned by the centre

⁸⁸ <http://www.research.gov.ro/ro/articol/4514/sistemul-de-cercetare-institute-na-ionale-de-cercetare-dezvoltare-in-coordonare>

⁸⁹ http://www.icpe.ro/performeri/files/Lista_Parcuri_Stiintifice_si_Tehnologice_Martie_2012.pdf

⁹⁰ <http://www.research.gov.ro/ro/articol/4728/sistemul-de-cercetare-infrastructuri-de-cercetare-infrastructura-de-inovare-si-transfer-tehnologic-entitati-de-inovare-si-transfer-tehnologic>

⁹¹ <http://economie.gov.ro/aparat-propriu/politici-industriale>

⁹² <http://www.ubm.ro/cit/>

⁹³ http://www.automation.ro/pdf/fisa_prez_IPA_eng.pdf

⁹⁴ <http://centruldeinformatica.ro/index.php/despre-noi/proiectele-noastre>

⁹⁵ <https://research.utcluj.ro/index.php/cttc-al-utcn.html>

- Support for companies looking to develop R&D programs
- Counselling and supporting start-ups

Of the 10 clusters in the North West region, two list technology as an area of expertise:

- The **iTech Transilvania** cluster⁹⁶, located in Cluj, comprises 64 members – among which 56 technology SMEs, 2 universities, 2 public authorities and 1 research institute. The cluster has a Silver rating from the ESCA
- The **Cluj IT** cluster⁹⁷, located in Cluj, comprises 34 companies, 6 universities and 10 public institutions. The cluster has a Silver rating from the ESCA

The North West region was host to approximately **3,000** IC&T companies at the end of 2016⁹⁸. After a significant decrease in the total number of companies between 2008-11, the number picked up again in 2012 and continued to grow until 2016 – a strong average growth rate of **8.1%** for the 2012-16 period.

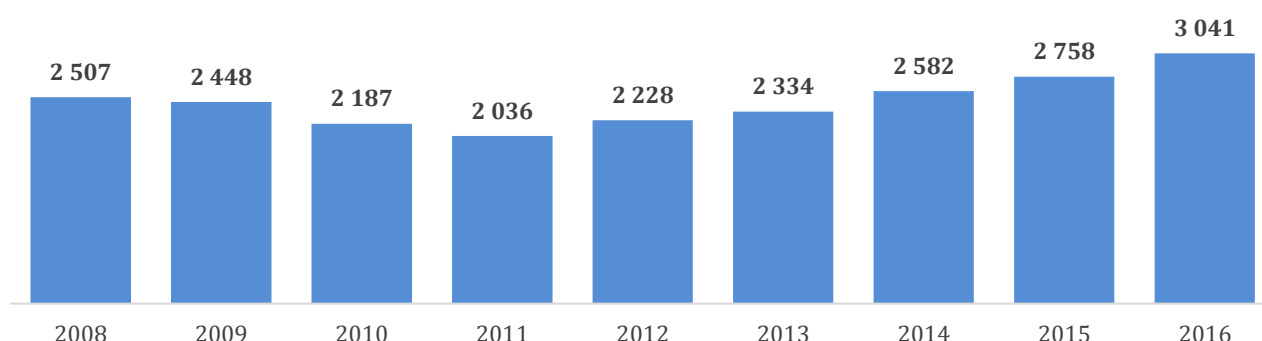


Figure 12: Number of IC&T companies – North West region

A similar trend can be observed when analysing the evolution of the total revenue generated by the IC&T sector in the North West region⁹⁹ – after a slight drop between 2008-09, the industry has recovered and grew at an average **14.8%** a year in the 2009-16 period. This is the strongest growth recorded among all analysed regions – as a comparison, the Bucuresti-Ilfov region only grew by an average **4.3%** a year in the same period.

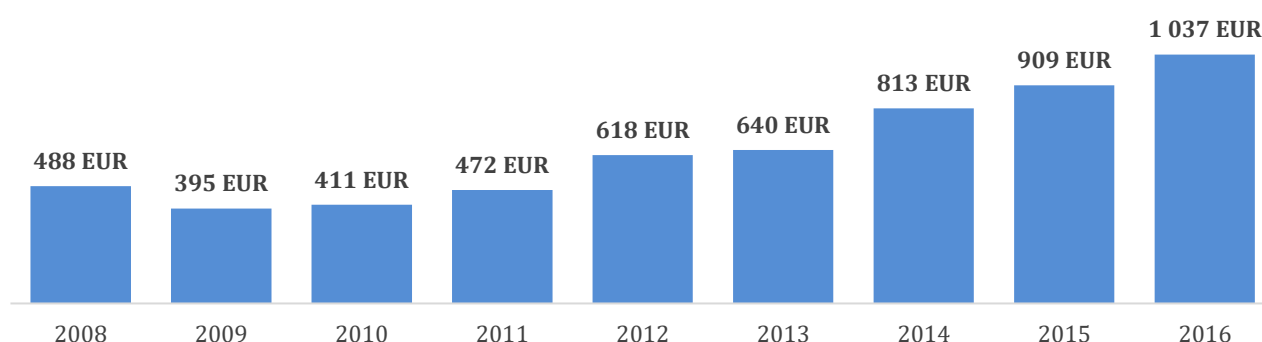


Figure 13: Total revenue of IC&T companies – North West region, Euro millions

⁹⁶ <https://itech.aries-transilvania.ro/prezentare-cluster/>

⁹⁷ <https://www.clujit.ro/>

⁹⁸ National Institute of Statistics

⁹⁹ National Institute of Statistics

From a structural point of view, **90%** of companies in the North West region are in the 0-9 employees segment. However, revenues generation is balanced among segments, with the largest 17 companies generating only around **37%** of all revenues.

Type of company	Total companies in 2016	% of total	2016 Revenues	
			(EUR Millions)	% of total
0-9 employees	2,738	90.0%	EUR 163	15.7%
10-49 employees	221	7.3%	EUR 177	17.1%
50-249 employees	65	2.1%	EUR 317	30.6%
+250 employees	17	0.6%	EUR 380	36.7%
Total	3,041	100%	EUR 1,037	100%

Demand-side barriers regarding the implementation of digital transformation

Romania ranks last in the Digital Economy and Society Index published by the European Commission¹⁰⁰. In the area of Integration of Digital Technology, which aims to quantify the digitisation of business and e-commerce, Romania's score is the lowest and 50% lower than the EU28 average.

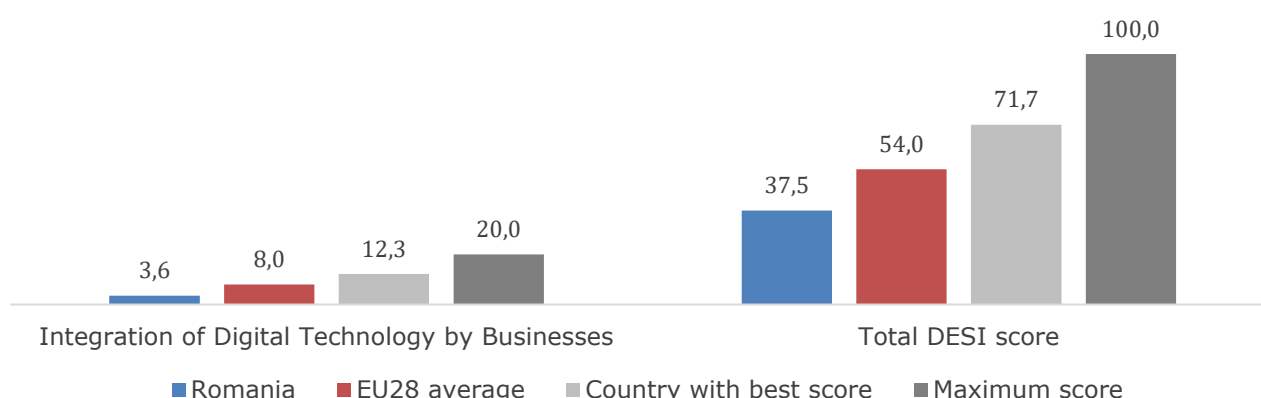


Figure 14: 2017 DESI score

Recent market surveys confirm that Romanian business leaders expect digitalisation to become a priority:

- According to the Connect Romania 2017 study¹⁰¹ commissioned by Cisco, **90%** of IT respondents expect digitalisation to become a significant topic in the next 3 years – **48%** expecting digitalisation to have a big impact on their companies
- According to the 2018 CIO Survey¹⁰² commissioned by Deloitte, Romanian CIOs believe digitalisation is a strategic priority, although they highlight that the concept lacks clarity and is interpreted differently among organisations

Structural macro-economic barriers

¹⁰⁰ <https://ec.europa.eu/digital-single-market/en/desi>

¹⁰¹ https://www.cisco.com/c/ro_ro/about/news/2017/171129.html

¹⁰² <https://doingbusiness.ro/articol/deloitte-cio-survey-creste-interesul-pentru-tehnologii-emergente-in-romania-3944>

The continuous growth of the Romanian IT&C industry, coupled with the relative high cross-border mobility of trained IT&C personnel, has led to a significant deficiency of qualified IT staff. Competition for personnel resources has led to a decoupling of wages and labour productivity – wages for IT staff in the North West region have increased by an average of **12.1%** in the 2008-16 period (highest growth among all analysed regions), whereas revenue/employee has decreased by an average of **2.8%**.¹⁰³

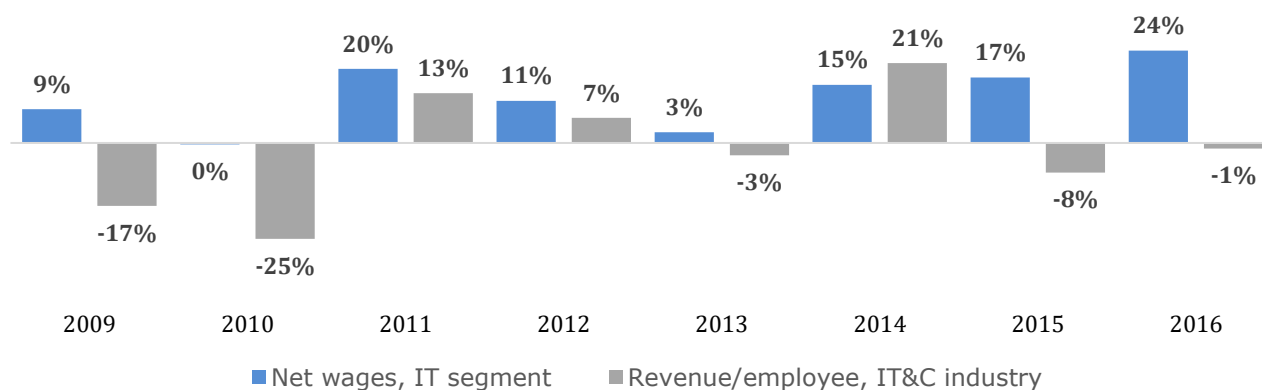


Figure 15: Year-on-year change in net wages and productivity – North West region

The competition for IT&C personnel is also evident in the evolution of the job vacancy ratio¹⁰⁴, which has increased significantly since 2009-10 and is the highest among all analysed regions.

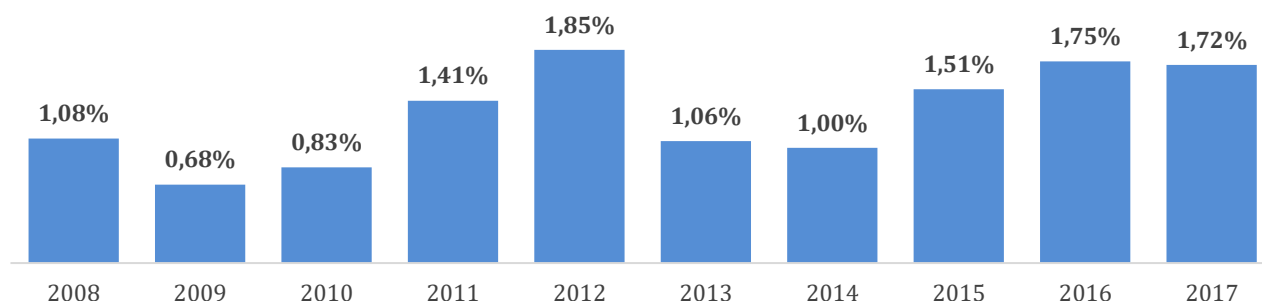


Figure 16: Job vacancy ratio – North West region, IT&C companies

Interviews with IT&C business leaders¹⁰⁵ highlight that recent changes made by the Romanian government to the tax system negatively affect IT&C companies. Expected consequences of the changes include:

- Switching cash from investments to wages, in order to compensate the wage decrease resulted from the new taxation system
- Lowering the number of new hires
- Switching employees to alternative forms of employment

Sources of available public finance for innovation projects

¹⁰³ PwC analysis based on National Institute of Statistics data

¹⁰⁴ The rate of job vacancies to total jobs, as measured by the National Institute of Statistics

¹⁰⁵ <https://startupcafe.ro/afaceri/anis-taxe-salarii-it-angajati.htm>

The 2014-2020 Regional Development Strategy¹⁰⁶ for the North West region identifies the need to increase the competitiveness of local companies and further stimulate research and innovation activities. Relevant potential actions include:

- Increasing SME competitiveness, as well as their ability to access international markets
- Further support R&D and innovation activities
- Incentivise entrepreneurship

As part of the implementation phase, the 2014-2020 Regional Operational Program¹⁰⁷ was designed to channel funding to the identified strategic issues. 13 funding axes were created, of which the first two are relevant to digital transformation initiatives:

1. Incentivise technology transfer activities
2. Increase competitiveness of SMEs

In addition to regional level funding, companies can also access national level funding. Alternatives include:

- The Competitiveness Operational Program¹⁰⁸, with two main axes:
 - Research, development and innovation to increase competitiveness – a total of **EUR 716 million** have been set aside for regions other than Bucuresti-Ilfov (including the North West region)
 - Using IT&C to increase competitiveness – a total of **EUR 555 million** have been set aside for regions other than Bucuresti-Ilfov (including the North West region)
- European grants¹⁰⁹
- Government subsidies/state aid¹¹⁰

2.2.11.4 South East region

The South East region contains 6 counties: Braila, Buzau, Galati, Constanta, Galati, Tulcea and Vrancea. The total population in the region amounted to **2.8 million** people in 2018¹¹¹, with Constanta (0.77 million people), and Galati (0.63 million people) the largest counties.

The region exhibited strong economic growth in the 2010-2015 period, with GDP/capita raising by an average of **5.4%** per year – from **EUR 4,554** in 2010 to **EUR 5,932** in 2015. Despite this growth, GDP/capita remains the lowest among all analysed regions – almost three times less than that of the Bucuresti-Ilfov region.¹¹²

¹⁰⁶ <https://www.nord-vest.ro/strategia-de-dezvoltare-regionala-2014-2020/>

¹⁰⁷ <http://www.nord-vest.ro/ghiduri-2014-2020/>

¹⁰⁸ <http://www.fonduri-ue.ro/poc-2014>

¹⁰⁹ <http://www.finantare.ro/calendar-granturi>

¹¹⁰ <http://www.finantare.ro/granturi-subventii/catalog-subventii>

¹¹¹ National Institute of Statistics

¹¹² PwC calculation based on National Institute of Statistics data

Region	Population ¹¹³	GDP ¹¹⁴ (EUR Millions)	GDP/capita ¹¹⁵	GDP/capita average growth ¹¹⁶
Bucuresti-Ilfov	2,535,798	EUR 44,497	EUR 17,882	7.2%
Centre (Brasov)	2,631,447	EUR 17,731	EUR 6,716	4.4%
North-West (Cluj)	2,833,298	EUR 18,373	EUR 6,469	5.0%
South-Est (Constanta)	2,841,720	EUR 17,139	EUR 5,932	5.4%
West (Timisoara)	2,005,512	EUR 15,174	EUR 7,502	3.7%

The South East region hosts two biology research institutes – due to the proximity to the Black Sea and Danube Delta, a fairly large number of clusters, but lacks science and technology parks and innovation and technology transfer institutions.

Region	Research institutes ¹¹⁷	Science technology parks ¹¹⁸	Innovation and technology transfer institutions ¹¹⁹	Clusters ¹²⁰
Bucuresti-Ilfov	31	1	14	18
Centre (Brasov)	1	-	5	16
North-West (Cluj)	1	-	9	10
South-Est (Constanta)	2	-	2	9
West (Timisoara)	3	1	4	1
Other regions	6	2	9	18
Total in Romania	44	4	43	72

The 2 innovation and technology transfer institutions listed for the South East region focus on environmental issues, bio-economy and tourism. They do not list information technology as a core competency.

Of the 10 clusters in the South East region, one lists technology as an area of expertise:

- The **Dunarea de Jos IT&C** cluster¹²¹, located in Galati, comprises 37 members. The cluster is not rated by the ESCA

¹¹³ National Institute of Statistics, data for the year 2018

¹¹⁴ National Institute of Statistics, data for the year 2015, latest available

¹¹⁵ National Institute of Statistics, data for the year 2015, latest available

¹¹⁶ Average growth for the 2010-15 time period. Calculated after the data was translated from RON to EUR. The EUR/RON yearly average exchange rate reported by the Romanian National Bank was used.

¹¹⁷ <http://www.research.gov.ro/ro/articol/4514/sistemul-de-cercetare-institute-na-ionale-de-cercetare-dezvoltare-in-coordonare>

¹¹⁸ http://www.icpe.ro/performance/files/Lista_Parcuri_Stiintifice_si_Tehnologice_Martie_2012.pdf

¹¹⁹ <http://www.research.gov.ro/ro/articol/4728/sistemul-de-cercetare-infrastructuri-de-cercetare-infrastructura-de-inovare-si-transfer-tehnologic-entitati-de-inovare-si-transfer-tehnologic>

¹²⁰ <http://economie.gov.ro/aparat-propriu/politici-industriale>

¹²¹ <https://clusterit.ro/>

The South East region was host to approximately **1,365** IC&T companies at the end of 2016¹²². After a significant decrease in the total number of companies between 2008-11, the number picked up again in 2012 and continued to grow until 2016. The growth was however not sufficient to bring the total number of companies back to its initial 2008 level.

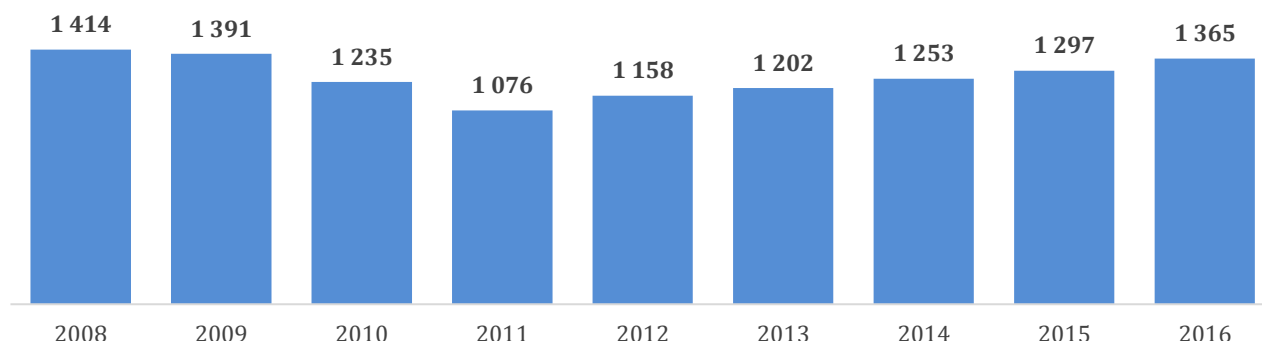


Figure 17: Number of IC&T companies South East region

A similar trend can be observed when analysing the evolution of the total revenue generated by the IC&T sector in the South East region¹²³ – after a slight drop between 2008-11, the industry bounced back in 2012 and has more or less remained at the same revenue level ever since.

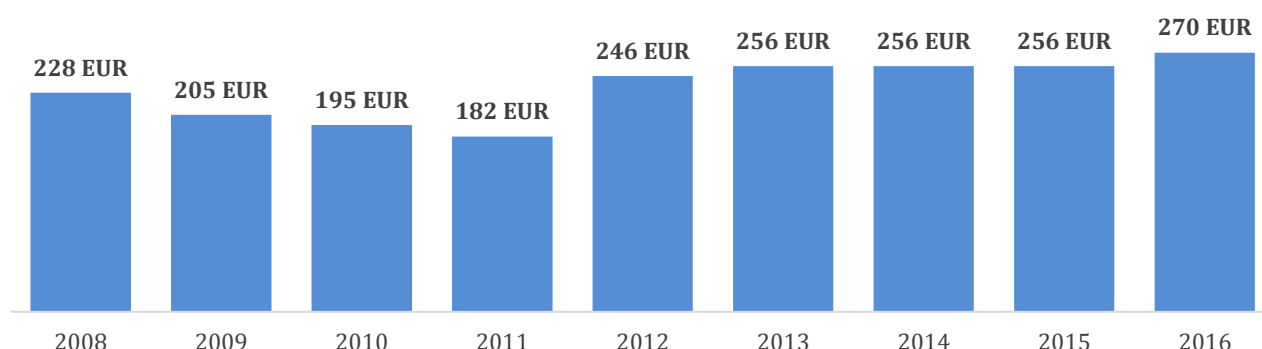


Figure 18: Total revenue of IC&T companies – South East region, Euro millions

From a structural point of view, **92%** of companies in the South East region are in the 0-9 employees segment. However, revenues generation is balanced among segments, with the largest 5 companies generating only around **25%** of all revenues.

Type of company	Total companies in 2016		2016 Revenues (EUR Millions)	
		% of total		% of total
0-9 employees	1,256	92.0%	EUR 81	30.0%
10-49 employees	82	6.0%	EUR 61	22.5%
50-249 employees	22	1.6%	EUR 67	22.8%
+250 employees	5	0.4%	EUR 61	24.8%
Total	1,365	100%	EUR 270	100%

¹²² National Institute of Statistics

¹²³ National Institute of Statistics

Demand-side barriers regarding the implementation of digital transformation

Romania ranks last in the Digital Economy and Society Index published by the European Commission¹²⁴. In the area of Integration of Digital Technology, which aims to quantify the digitisation of business and e-commerce, Romania's score is the lowest and 50% lower than the EU28 average.

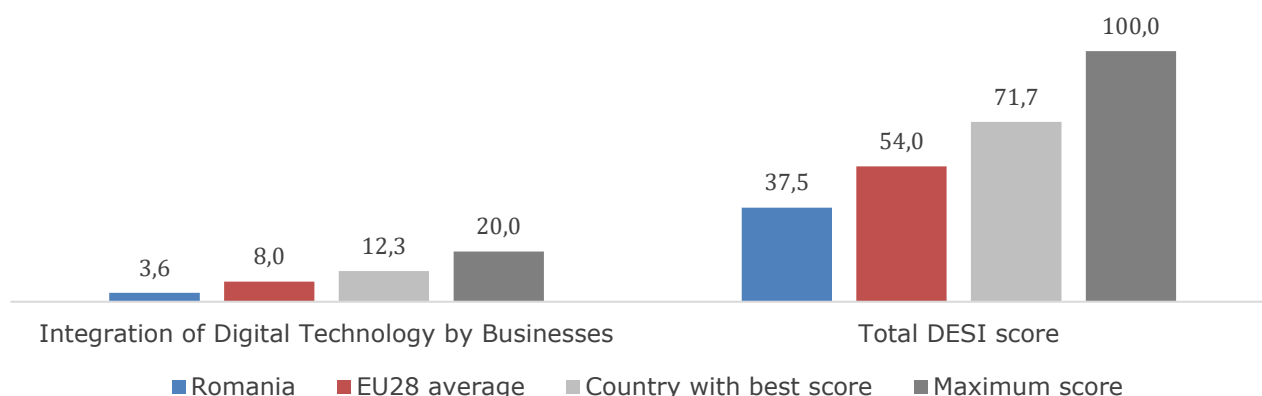


Figure 19: 2017 DESI score

Recent market surveys confirm that Romanian business leaders expect digitalisation to become a priority:

- According to the Connect Romania 2017 study¹²⁵ commissioned by Cisco, **90%** of IT respondents expect digitalisation to become a significant topic in the next 3 years – **48%** expecting digitalisation to have a big impact on their companies
- According to the 2018 CIO Survey¹²⁶ commissioned by Deloitte, Romanian CIOs believe digitalisation is a strategic priority, although they highlight that the concept lacks clarity and is interpreted differently among organisations

Structural macro-economic barriers

The South East region seems to be less affected by the strong increase in IT wages evident in other regions – wages have only increased at a light **0.6%** average growth rate in the 2008-16 period. However, labour productivity has seen the largest decrease in all analysed regions, dropping at an average **6.1%** in the same period. This situation could indicate that IT labour resources are poorly qualified¹²⁷

¹²⁴ <https://ec.europa.eu/digital-single-market/en/desi>

¹²⁵ https://www.cisco.com/c/ro_ro/about/news/2017/171129.html

¹²⁶ <https://doingbusiness.ro/articol/deloitte-cio-survey-creste-interesul-pentru-tehnologii-emergente-in-romania-3944>

¹²⁷ PwC analysis based on National Institute of Statistics data

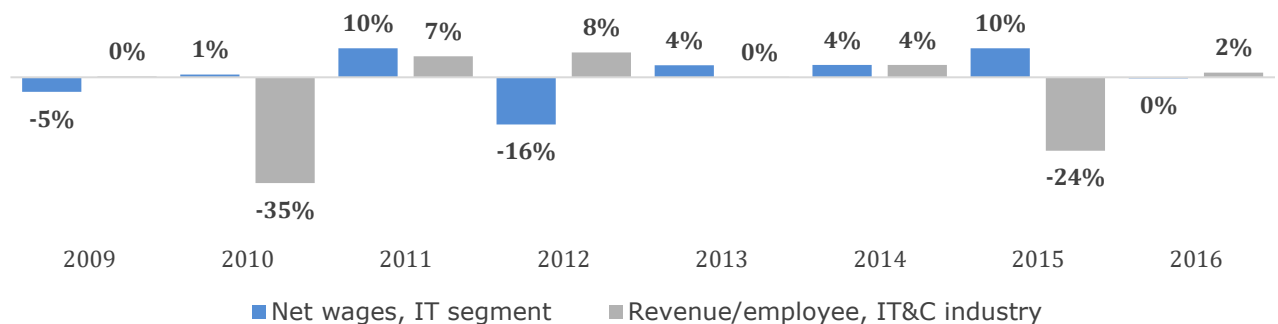


Figure 20: Year-on-year change in net wages and productivity – South East region

The growth in the job vacancy ratio¹²⁸ seems to validate this conclusion: companies are looking for IT staff but since most employees are poorly qualified, it makes little sense to increase wages and companies accept a productivity drop.

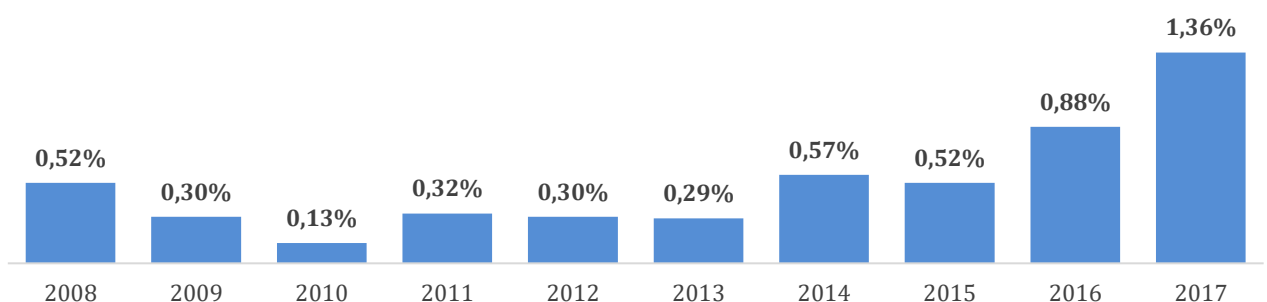


Figure 21: Job vacancy ratio – South East region, IT&C companies

Interviews with IT&C business leaders¹²⁹ highlight that recent changes made by the Romanian government to the tax system negatively affect IT&C companies. Expected consequences of the changes include:

- Switching cash from investments to wages, in order to compensate the wage decrease resulted from the new taxation system
- Lowering the number of new hires
- Switching employees to alternative forms of employment

Sources of available public finance for innovation projects

The 2014-2020 Regional Development Strategy¹³⁰ for the South East region identifies the need to increase the competitiveness of local companies through a deeper, smarter specialisation strategy. Relevant potential actions include:

- Developing R&D and technology transfer centres

¹²⁸ The rate of job vacancies to total jobs, as measured by the National Institute of Statistics

¹²⁹ <https://startupcafe.ro/afaceri/anis-taxe-salarii-it-angajati.htm>

¹³⁰ http://www.adrse.ro/Documente/Planificare/PDR/2014/PDR.Sud_Est_2014.pdf

- Extending local production capacities
- Developing the number of services available to local companies
- Increasing the quality of local human resources

As part of the implementation phase, the 2014-2020 Regional Operational Program¹³¹ was designed to channel funding to the identified strategic issues. 10 funding axes were created, of which the first two are relevant to digital transformation initiatives:

1. Incentivise technology transfer activities – a total of **EUR 31 million** have been set aside for the South East region
2. Increase competitiveness of SMEs – a total of **EUR 102 million** have been set aside for the South East region

In addition to regional level funding, companies can also access national level funding. Alternatives include:

- The Competitiveness Operational Program¹³², with two main axes:
 - Research, development and innovation to increase competitiveness – a total of **EUR 716 million** have been set aside for regions other than Bucuresti-Ilfov (including the South East region)
 - Using IT&C to increase competitiveness – a total of **EUR 555 million** have been set aside for regions other than Bucuresti-Ilfov (including the South East region)
- European grants¹³³
- Government subsidies/state aid¹³⁴

2.2.11.5 West region

The West region contains four counties: Timis, Arad, Caras Severin and Hunedoara. The total population in the region amounted to **2 million** people in 2018¹³⁵, with Timis (0.75 million people) the largest county.

The region exhibited the smallest economic growth of all analysed regions in the 2010-2015 period, with GDP/capita raising by an average of **3.7%** per year – from **EUR 6,253** in 2010 to **EUR 7,502** in 2015. The absolute value of the GDP/capita is the second highest among analysed regions, after Bucuresti-Ilfov.¹³⁶

Region	Population ¹³⁷	GDP ¹³⁸ (EUR Millions)	GDP/capita ¹³⁹	GDP/capita average growth ¹⁴⁰
Bucuresti-Ilfov	2,535,798	EUR 44,497	EUR 17,882	7.2%

¹³¹ http://www.adrse.ro/Documente/POR_2014/Inforegio/Brosura_POR.2014-2020_Informatii_generale.pdf

¹³² <http://www.fonduri-ue.ro/poc-2014>

¹³³ <http://www.finantare.ro/calendar-granturi>

¹³⁴ <http://www.finantare.ro/granturi-subventii/catalog-subventii>

¹³⁵ National Institute of Statistics

¹³⁶ PwC calculation based on National Institute of Statistics data

¹³⁷ National Institute of Statistics, data for the year 2018

¹³⁸ National Institute of Statistics, data for the year 2015, latest available

¹³⁹ National Institute of Statistics, data for the year 2015, latest available

¹⁴⁰ Average growth for the 2010-15 time period. Calculated after the data was translated from RON to EUR. The EUR/RON yearly average exchange rate reported by the Romanian National Bank was used.

Centre (Brasov)	2,631,447	EUR 17,731	EUR 6,716	4.4%
North-West (Cluj)	2,833,298	EUR 18,373	EUR 6,469	5.0%
South-Est (Constanta)	2,841,720	EUR 17,139	EUR 5,932	5.4%
West (Timisoara)	2,005,512	EUR 15,174	EUR 7,502	3.7%

The West region hosts two research institutes in Timisoara and one in Petrosani, a science and technology park, but lacks clusters.

Region	Research institutes ¹⁴¹	Science technology parks ¹⁴²	Innovation and technology transfer institutions ¹⁴³	Clusters ¹⁴⁴
Bucuresti-Ilfov	31	1	14	18
Centre (Brasov)	1	-	5	16
North-West (Cluj)	1	-	9	10
South-Est (Constanta)	2	-	2	9
West (Timisoara)	3	1	4	1
Other regions	6	2	9	18
Total in Romania	44	4	43	72

The **TIM SCIENCE PARK**¹⁴⁵ is located in Timisoara and acts as part of the Electrochemistry Research Institute. It aims to:

- Support local R&D activities
- Attract, train and support research talent
- Transfer technology and bring to market the results of R&D projects
- Incubate companies, Romanian or foreign, interested in offering products and services in the science parks' competency areas
- Organise conferences and edit publications to disseminate scientific know-how

Of the four innovation and technology transfer institutions in the West region, one lists information technology as an area of expertise:

- The **CTT ETA2U INNOVATION** technology transfer centre¹⁴⁶ focuses mainly on research activities funded through the Horizon 2020 program (e.g. a project carried out in 2012 to explore solutions to use satellite broadband in underserved European regions)

¹⁴¹ <http://www.research.gov.ro/ro/articol/4514/sistemul-de-cercetare-institute-na-ionale-de-cercetare-dezvoltare-in-coordonare#Prezentare>

¹⁴² http://www.icpe.ro/performer/files/Lista_Parcuri_Stiintifice_si_Tehnologice_Martie_2012.pdf

¹⁴³ <http://www.research.gov.ro/ro/articol/4728/sistemul-de-cercetare-infrastructuri-de-cercetare-infrastructura-de-inovare-si-transfer-tehnologic-entitati-de-inovare-si-transfer-tehnologic>

¹⁴⁴ <http://economie.gov.ro/aparat-propriu/politici-industriale>

¹⁴⁵ <https://www.incemc.ro/index.php?page=tsp.html>

¹⁴⁶ <https://www.eta2u.ro/index.php/despre-eta2u-innovation>

The **Banat Software** cluster¹⁴⁷, located in Timisoara, aims to increase the competitiveness of IT&C companies in the Timis and Caras Severin counties in Romania, as well as three neighbouring counties in Serbia. The cluster has a Bronze rating from the ESCA.

The West region was host to approximately **1,566** IC&T companies at the end of 2016¹⁴⁸. After a significant decrease in the total number of companies between 2008-11, the number picked up again in 2012 and continued to grow steadily until 2016 – an average **5.3%** growth rate.

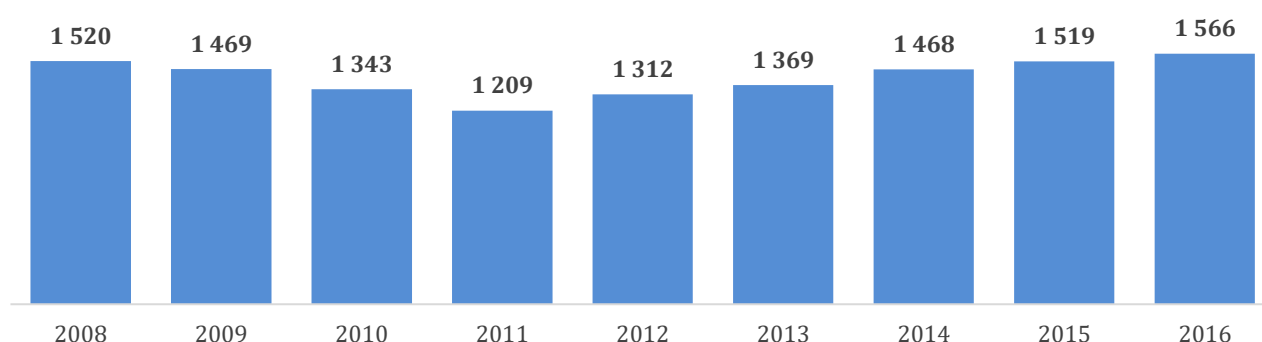


Figure 22: Number of IC&T companies – West region

A similar trend can be observed when analysing the evolution of the total revenue generated by the IC&T sector in the West region¹⁴⁹. After a significant drop between 2008-11, the industry bounced back in 2012 and has grown at an average rate of **13%** for the 2011-16 period – the only analysed region to post a double-digit growth rate after the North West region.

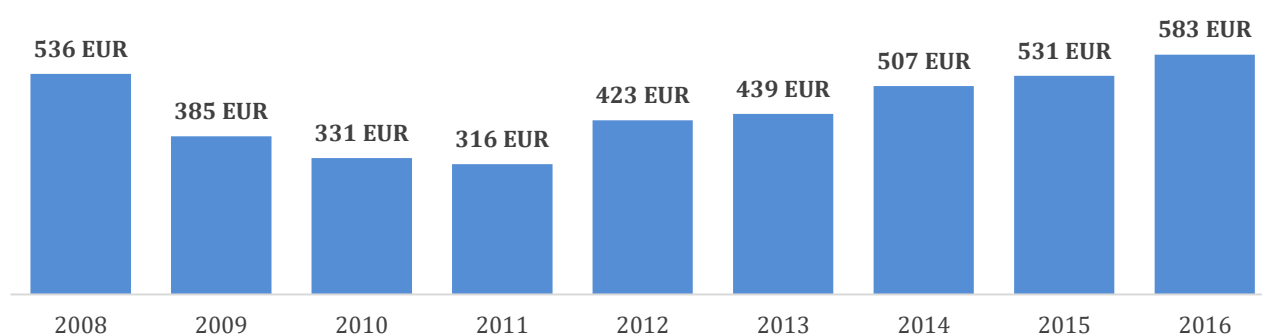


Figure 23: Total revenue of IC&T companies – West region, Euro millions

From a structural point of view, **90%** of companies in the South East region are in the 0-9 employees segment and only **10** companies have more than 250 employees. However, companies with more than 50 employees, that together generate **67%** of all revenues, dominate revenue generation.

Type of company	Total companies in 2016		2016 Revenues (EUR Millions)	
		% of total		% of total
0-9 employees	1,404	89.7%	EUR 92	15.7%

¹⁴⁷ <http://www.banatsoftware.ro/ro/despre+proiect>

¹⁴⁸ National Institute of Statistics

¹⁴⁹ National Institute of Statistics

10-49 employees	114	7.3%	EUR 99	17.0%
50-249 employees	38	2.4%	EUR 205	35.2%
+250 employees	10	0.6%	EUR 187	32.1%
Total	1,566	100%	EUR 583	100%

Demand-side barriers regarding the implementation of digital transformation

Romania ranks last in the Digital Economy and Society Index published by the European Commission¹⁵⁰. In the area of Integration of Digital Technology, which aims to quantify the digitisation of business and e-commerce, Romania's score is the lowest and 50% lower than the EU28 average.

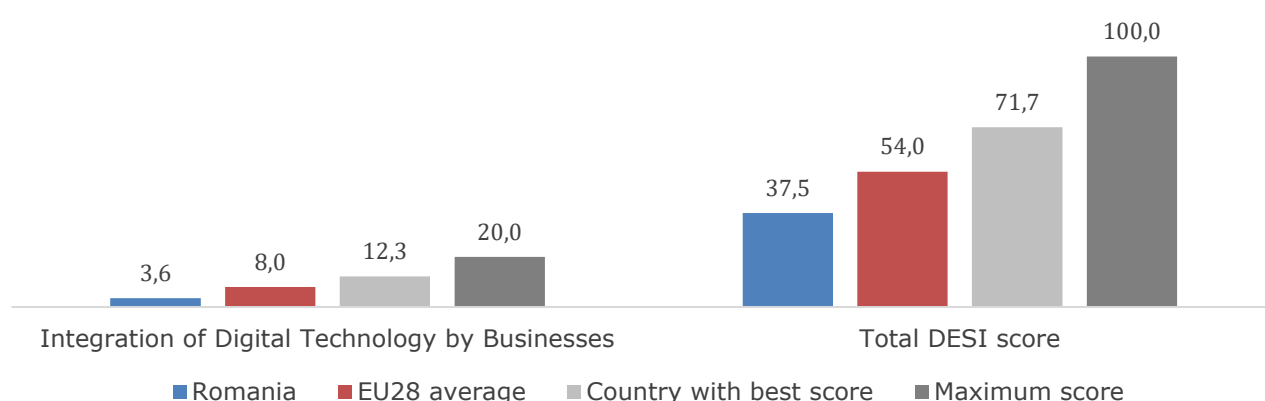


Figure 24: 2017 DESI score

Recent market surveys confirm that Romanian business leaders expect digitalisation to become a priority:

- According to the Connect Romania 2017 study¹⁵¹ commissioned by Cisco, **90%** of IT respondents expect digitalisation to become a significant topic in the next 3 years – **48%** expecting digitalisation to have a big impact on their companies
- According to the 2018 CIO Survey¹⁵² commissioned by Deloitte, Romanian CIOs believe digitalisation is a strategic priority, although they highlight that the concept lacks clarity and is interpreted differently among organisations

Structural macro-economic barriers

The continuous growth of the Romanian IT&C industry, coupled with the relative high cross-border mobility of trained IT&C personnel, has led to a significant deficiency of qualified IT staff. Competition for personnel resources has led to a decoupling of wages and labour productivity – wages for IT staff in the North West region have increased by an average of **6.7%** in the 2008-16 period, whereas revenue/employee has decreased by an average of **3.3%**.¹⁵³ The average IT wage in the West region is on par with those in Bucuresti-Ilfov and North West (Cluj) regions.

¹⁵⁰ <https://ec.europa.eu/digital-single-market/en/desi>

¹⁵¹ https://www.cisco.com/c/ro_ro/about/news/2017/171129.html

¹⁵² <https://doingbusiness.ro/articol/deloitte-cio-survey-creste-interesul-pentru-tehnologii-emergente-in-romania-3944>

¹⁵³ PwC analysis based on National Institute of Statistics data

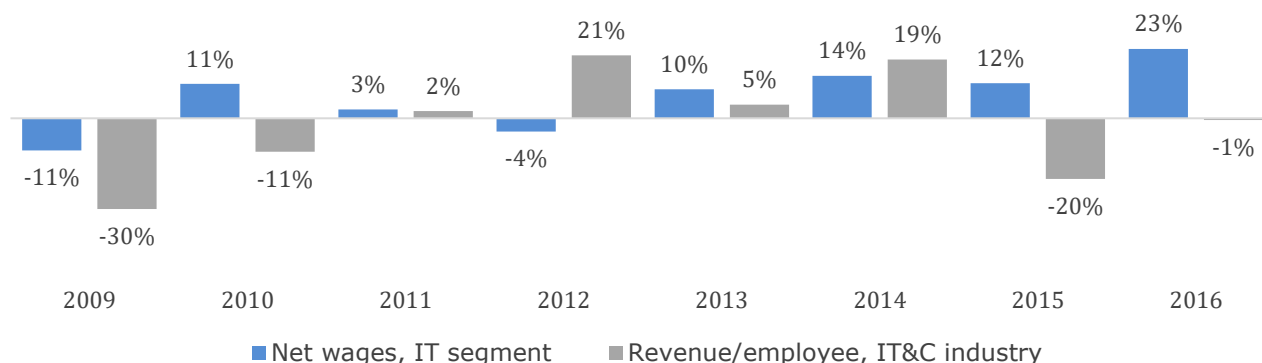


Figure 25: Year-on-year change in net wages and productivity – West region

The competition for IT&C personnel is also evident in the evolution of the job vacancy ratio¹⁵⁴, which has increased by approximately **1 p.p.** since 2008.

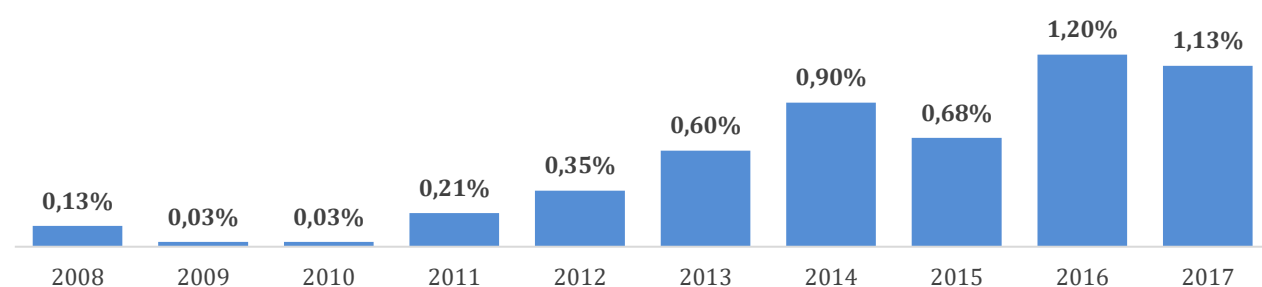


Figure 26: Job vacancy ratio West region, IT&C companies

Interviews with IT&C business leaders¹⁵⁵ highlight that recent changes made by the Romanian government to the tax system negatively affect IT&C companies. Expected consequences of the changes include:

- Switching cash from investments to wages, in order to compensate the wage decrease resulted from the new taxation system
- Lowering the number of new hires
- Switching employees to alternative forms of employment

Sources of available public finance for innovation projects

The 2014-2020 Regional Development Strategy¹⁵⁶ for the West region identifies two relevant strategic objectives:

- Increase regional competitions through increased innovation and intelligent specialisation
- Increase productivity and foster entrepreneurship

¹⁵⁴ The rate of job vacancies to total jobs, as measured by the National Institute of Statistics

¹⁵⁵ <https://startupcafe.ro/afaceri/anis-taxa-salarii-it-angajati.htm>

¹⁵⁶ <https://adrvest.ro/wp-content/uploads/2016/09/PDR-2014-2020-ro.pdf>

Relevant potential actions include:

- Support the formation of Competence Centres in the region
- Encourage private investment in R&D
- Support the set up and delivery of business support services
- Improve the existing communication infrastructure
- Promote advanced software applications

As part of the implementation phase, the 2014-2020 Regional Operational Program¹⁵⁷ was designed to channel funding to the identified strategic issues. 10 funding axes were created, of which the first two are relevant to digital transformation initiatives:

1. Incentivise technology transfer activities – a total of **EUR 24** million have been set aside for the West region
2. Increase competitiveness of SMEs – a total of **EUR 80** million have been set aside for the West region

In addition to regional level funding, companies can also access national level funding. Alternatives include:

- The Competitiveness Operational Program¹⁵⁸, with two main axes:
 - Research, development and innovation to increase competitiveness – a total of **EUR 716 million** have been set aside for regions other than Bucuresti-Ilfov (including the West region)
 - Using IT&C to increase competitiveness – a total of **EUR 555 million** have been set aside for regions other than Bucuresti-Ilfov (including the West region)
- European grants¹⁵⁹
- Government subsidies/state aid¹⁶⁰

2.2.12 Slovakia

2.2.12.1 Presov

Prešov self-government region is located in Eastern Slovakia bordering with Hungary in the south, Ukraine in the east and Poland in the north. The biggest cities in the region - Prešov (as the self-governing regions is named) is the third biggest in Slovakia. According to Slovak Business Agency there were 70,616 SMEs in Prešov region from which approx. 97.3% were defined as active micro-enterprises in 2017. The most frequent are SMEs in the field of services (34.6%), important are also the industrial SMEs (16.9%). The 9,304 newly established SMEs could be a nice indicator of entrepreneurship boom in the region. On the other hand, there were also 8,093 SMEs terminations in 2017. The entrepreneurship gender structure shows the huge dominance of male entrepreneurs with 77% as the highest ratio in the whole

¹⁵⁷ http://www.adrse.ro/Documente/POR_2014/Inforegio/Brosura_POR.2014-2020_Informatii_generale.pdf

¹⁵⁸ <http://www.fonduri-ue.ro/poc-2014>

¹⁵⁹ <http://www.finantare.ro/calendar-granturi>

¹⁶⁰ <http://www.finantare.ro/granturi-subventii/catalog-subventii>

Slovakia. The positive indication is seen in the high ratio 17.9% of young entrepreneurs under 30 and low elderly entrepreneurs over 60 with ratio of 8.7%.

Prešov region is still missing adequate motorway and highway network where only D1 highway from western Slovakia is constructed to city entrance and continues to the south from Prešov as the main connection between Prešov and Kosice. Other motorway and highway network especially main northern corridor to Poland as well as eastern corridor extension of D1 to Ukraine is under preparation and only a small part of D1, the south-west Prešov by-pass is under construction. As to the railway transport, Košice is conducted by the express trains and fast trains as from the main railway corridor from western to Eastern Slovakia. There is quite often necessity to change the train when travelling to Prešov the main railway corridor bypasses the city. There is the second biggest airport in Košice with 9 destinations off-season direct flights. Other relevant airport is situated in Poprad.

In Prešov is situated the University of Prešov (PU) with focus on humanities. The most relevant from PU is the Faculty of Management. There is also situated the Faculty of Manufacturing Technologies at TUKE. The faculty makes effort to prepare its students for the best possible industry conditions, and therefore it is actively involved in the national project called "Universities as Engines of the Knowledge Society Development". It has been placed second among 143 faculties in Slovakia in terms of the viability and relevance of study programs to the needs of practical implementation. Currently the faculty is starting cooperation in SPICE (Students Programme of Integrated Education Company), a joint project of the Association of Automotive Industry of the Slovak Republic and the National Development Project AZU.sk.

Technology centres with regional reach:

- University science park Technicom with the main goal of connecting science with industry and supporting technology transfer and innovation. The park offers intellectual property protection services, educational and legal services, supporting the management and administration of project services, support activities and formation of partnerships with relevant cooperation in the area of technology transfer. It also supports expert and mentoring for intentions to TUKE departments and partners, joint research and development innovative workplaces, as well as to be competence centres in the field of digital support for the development of smart technologies in production and integrated support of development of renewable energy sources. The main research competence is in information and communication technologies, electrical engineering, automation and control system, mechanical, civil and environmental engineering.
- University centre of innovation, technology transfer and intellectual property protection was established in 2012 with aim to support cooperation in the field of applied research, innovation and technology transfer from academic environment to industry, support for scientific, research and innovation projects, support for the intellectual property protection for outputs of TUKE scientific and research activities. The others are support for human resource development and service methodologies for these areas, marketing support for innovation results, technology transfer, and portal information system.
- Unipolab is the newest technology park established in cooperation with the University of Prešov, Pavol Jozef Šafárik University and University of Technology in Košice and in May 2018 with the main concentration in environmental

engineering, development of perspective materials for magnetic cooling in praxis – providing heat capacity measurement and heat transfer. Another researches are made in organics isolation from plants, green synthesis of metal nanoparticles. The beneficiaries are researches in natural sciences and their application and the transfer of innovation into practice.

- Košice IT valley as an association was established in 2007 as a joint initiative of educational institutions, government and leading IT companies. In 2012 it was transformed into the cluster. In 2015 the cluster was certified for "Cluster Management Excellence Label GOLD" as the first in central Europe and is one of three certified clusters in the area of information and communication technologies. Its activities orientates on motivation of children and youth to study and later to work in the Information Technologies and Robotics, improving the quality of IT training programs offered by universities, high and elementary schools and IT businesses, preparation and implementation of joint scientific – research projects and providing consultancy in this area, supporting the members' coordination as well as elaboration of studies for further development of region and society.

Moreover, the Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that SMEs, are relative equal to EU-average with respect to innovation-collaboration and in-house innovations.

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. The main points of economic development areas are:

- **Automotive and mechanical engineering industries** with increasing the value added of domestic products, in particular by transferring technology and the results of science and research into the production process, energy efficiency and renewable energy sources. Development of technological investment units, particularly in the field of energy and industrial facilities, with a view to internationalisation of activities and development of "Emerging countries".
- **Consumer electronics and electrical equipment.** The development of industry-friendly manufacturing practices geared to better use of available resources, higher recycling rates and the use of environmentally friendly materials through the use of science and technology development and innovation. "
- **Information and communication technologies and services**, which goal is to create new solutions in usage of robotics and ICT in production processes. Companies will be able to streamline production and logistics processes that will result in total energy intensity reduction and in the implementation of information and communication technologies in intelligent applications in industry.
- **Production and processing of iron and steel**, The development of technological investment units, particularly in the fields of metallurgy, engineering, energy and integrated industrial equipment, with regard to the application and use of light metals and modern materials in the production of transport and construction techniques.

Demand-side barriers regarding the implementation of digital transformation

One of the structural problems in the whole Slovakia is its low level of enterprises' digitalisation. Deputy Prime Minister's Office for Investments and Informatisation of the Slovak Republic as the major authority is responsible for spreading the unified digital market strategy, national concept of public sector informatisation and the technical support of projects. Although the informatisation process has already been launched the digitalisation in both public and private sector is behind the estimated time schedule. The objectives of the Digital Agenda for Europe by 2020 is the introduction and operation of fast broadband at min. 30 Mbit/s for EU citizens by 2020. Other agenda is to target approx. 1 800 identified blank spots most of them in the Prešov region where such fast networks were not available. After excluding high-tech companies, most of regional SMEs seem to be unaware of possibilities offered by digitalisation.

There is also a task concerning minor opinion about digital skills improvement of population. It is essential to change the population mind-set related to the education and competency for the usage of modern technologies. This approach should be applied even for the part of population who do not have enough financial resources to buy such technologies as it is very important as part of IT inclusion.

As to the huge IT transformation projects in the private sector there can be seen a complication in its financing and decision-making competencies. The most visible lack of decision-making power is at local management level where the standard IT implementation projects are dependent upon approval of its headquarters. Current situation already prolongs the implementation of new IT software solutions and well as possible enforcing of local software service providers.

In order to implement and develop digital transformation in the Prešov region, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for value added creation and servitisation, attracting external and foreign funding to leverage investment risks.

Structural macro-economic barriers

A frequently changing legislative environment makes it difficult and costly for companies to comply with legislation, and legislative and regulatory processes are often viewed as insufficiently business-friendly. The lack of eGovernment services complicates business interactions with authorities. Perceptions of corruption and favouritism are rife, especially in public procurement.

The justice system in Slovakia continues to face challenges with regard to its overall ineffectiveness. While efficiency has started to increase, the workload of the courts remains high.

The regional GDP in Prešov region is approx. 7,5 m EUR which means 9,2% of Slovak GDP. Concerning the population in region the GDP per capita is only 61% of average national GDP which pushes the region among 2 most underdeveloped in the whole Slovakia.

Eastern Slovakia is affected by regional disparities caused by lack of adequate infrastructure, investments in education and further research and development which displays in brain-drain. Despite one of the highest ratio of rural population there is a significant need of commuting due to workforce demand in the cities as local and regional centres.

Prešov region has high unemployment rate of 9,68% in 2017, which is more than three percentage points higher than national unemployment rate in Slovakia. There is a big brain-drain issue in the region as there are some government and third sector initiatives to prevent those emigrations such as LEAF organisation that assists Slovaks when moving back from abroad and contribute to a better quality of life. The labour costs increase is most visible in the big cities with lack of adequate educated labour force.

Unfortunately, infrastructural development of Prešov region is poor. Only one highway D1, and one express-class railway direction Bratislava - Košice has been constructed yet, so produced goods do not have adequate transfer lanes from factory to customer. Infrastructural underdevelopment is a fundamental development barrier for both eastern regions industry. There are more motorways which will conduct municipalities under preparation and some of them will be under construction hopefully in coming years.

Sources of available public finance for innovation projects

A high-level research of available public financing of innovation and digitisation in Prešov region have shown that such funding is based almost exclusively on funds from the EU.

The most significant source of public finance from the Structural funds is the Operational Program 2014 – 2020 Research and Innovation. Ministry of Economy of the Slovak Republic and Ministry of Education, Science, Research and Sport of the Slovak Republic administer this program together.

Financial coverage of the operational program has been set at 2 266 776 537 EUR by the European Commission. There are three types of calls for proposals available in this program.

1. Demand-oriented projects

Small and medium sized enterprises as well as research institutions can apply for demand-oriented projects.

Examples of past calls for proposals:

- Support of creation and activities of technological innovation platforms within individual economic sectors
- Encouragement of SMEs to join EU programs
- Support of innovation through industrial research and experimental development with the Digital Slovakia and Creative Industry domain
- Support of innovation through industrial research and experimental development with the Industry for 21. century domain

2. National projects

National project is a project with focus, character of activities, geographical reach, and other attributes that tackles areas with national impact in complex and systemic way. A beneficiary based on donor's request realises national project.

Examples of call for proposals:

- Support of creative industry development in Slovakia
- Support of internationalisation of SMEs
- Increase of innovation performance of Slovak economy

3. Financial instruments

Intention of implementation of financial instruments is to provide financial resources in areas of technological development, innovations, research and development, and competitiveness. Financial instruments can take form of loans, guarantees, venture capital, and other forms of capital financing.

Calls for proposals were directly addressed to selected institutions.

The Interreg Europe programme, financed by the European Regional Development Fund (ERDF) is designed to support knowledge sharing among policy organisations among different regions. The program does not support commercial firms. However, public authorities, regional development agencies, business support organisation, universities, or private non-profit bodies are eligible for Interreg funding. The program's focus topics are:

- Research, technological development and innovation
- Competitiveness of SMEs
- Low-carbon economy
- Environment and resource efficiency.

Commercial firms as well as not-for profit institutions can receive funding the European level from the largest EU research and innovation program Horizon 2020.

Public funds are also available through microfinancing schemes where small companies can receive up to 50 000 EUR with an interest rate starting at 0,61%. Funding is available through both public and non-governmental bodies supported by governmental structures.

Sources of private sector finance for innovation projects

Start-ups in their early stages have access to private funding through business angel investors. A platform that brings such investors together is called Slovak Business Angels Network and young start-ups can approach potential investors here.

More mature start-ups can get financing via venture capital funds. Venture capital market has been growing in Slovakia during past years quite significantly. Start-ups in Prešov and Košice regions can find opportunities for venture capital funding for example at Neulogy Ventures, Národný holdingový fond (National Holding Fund), Fond inovácií a technológií (Innovation and Technology Fund), Slovenský rozvojový fond, a.s. (Slovak Development Fund), or Slovenský rastový kapitálový fond (Slovak Capital Growth Fund). Even though these funds are not based in these regions, they have national reach.

Prešov region does not offer many services such as business incubators and accelerators. Since incubators and accelerators often provide mentoring services, professional consulting and premises on top of funding, they would be very beneficial for development of this region. The most relevant incubators and accelerators in Prešov region are RPIC and Entrepreneurial Incubator in Spišská Nová Ves.

Financial support of innovation is not only available for start-ups. Established companies can of course receive funding from banks and from private equity funds such as ARX Equity Partners, Enterprise Investors, Genesis Capital, s.r.o., or Limerock Fund Manager.

Positive and negative examples of initiatives undertaken in the region

Initiatives regarding innovation and digitisation have rather national than regional character. Below are few examples of such initiatives.

Google runs a non-profit initiative called Digital garage. Goal of this initiative is to teach individual digital skills to enhance their businesses or carriers. Digital Garage introduces learners to different tools and teaches them how to utilise their full potential. Everything is in a form of interactive online courses.

There is also governmental initiative called Digital Coalition. Its goal is to popularise topic of digitisation in Slovakia. In order to do this, Digital Coalition brings together public, private, and academic institutions and each member has to formulate his commitment. We will have to wait to see the commitments to come to practice.

The number of women studying IT in Slovakia used to be as low as 3-5% of all IT students in Slovak universities in 2012. Initiative *Aj ty v IT* tackles this problem by trying to increase interest in IT in Slovak women. The initiative organises events, provides support, and runs programming academy. They have set the goal that there will be 30% of women on IT faculties in Slovakia.

The Slovak Alliance for Innovation Economy (SAPIE) is the largest innovative alliance in Slovakia. It is a leading forum for debate on digital economy and innovation in Slovakia consisting of independent and non-profit platform connecting more than 60 innovative companies. The aim is to support initiatives that help to increase the reach of digital education, entrepreneurship and creative skills among students, teachers and parents. These initiatives have the potential to close the gap between the 'haves' and the 'have-nots' of digital economy and help to create an innovation-friendly culture.

2.2.12.2 Bratislava

Bratislava self-government region is located in south-western part of Slovakia bordering with Austria in the west and Hungary in the south. The capital city is the wealthiest and most economically prosperous region in Slovakia. Companies with the highest value added operating mainly in Bratislava, include the Volkswagen Bratislava Plant, Slovnaft refinery, SPP, Eset, Asseco, PPC Power, etc.

According to Slovak Business Agency, there were 126 464 SMEs in Bratislava region from which approx. 96.6% were defined as active micro-enterprises in 2017. The centre of business activities was Bratislava II district with concentration of approx. 22.3% of all SMEs. The most frequent are SMEs in the field of services (62.7%), with most important in the retail (20.4%). Other positive results could be seen in transportation and information services with (11,4%). There were 13 112 newly established SMEs i.e. 20% of all new established SMEs in Slovakia. On the other hand there were also 8 517 SMEs termination in 2017 representing more than 16% in Slovakia. Almost a third of them were SMEs in retail services. As the gender structure shows the most significant entrepreneurial activity for women among all Slovak regions with 36%. The Bratislava region is long-term known as the least positive region for young entrepreneurs under 30 with ratio 10.3%. On the other hand there is the biggest (14.7%) elderly entrepreneurs over 60 among all Slovak regions. One

of the key factors is the aging of population which caused 1.7 percentage points increase in last 5 years. There is also the high-tech industry field introduced by 7.4% of all SMEs registered in industry and services categories.

Bratislava definitely is considered as the students' city. The list of universities relevant for smart factories cooperation consists of the Comenius University in Bratislava (UNIBA), the Slovak University of Technology in Bratislava (STU), the University of Economics in Bratislava (EUBA), City University of Seattle e.i.

UNIBA operating as the humanities university shows its' relevance in the Faculty of Mathematics, Physics and Informatics which is consistently ranked as the best faculty in Slovakia. Students are encouraged to contribute to international projects with involvement of our faculty members. Examples include: Mars exploration projects with NASA, quantum computing and laser-based communication with Princeton University, discovery of new heavy elements with GSI Darmstadt, experiments on the largest particle collider with CERN. The faculty has modern laboratories, including Astronomy and Geophysics Observatory or Centre of Excellence for Physics of Complex Systems.

The Slovak University of Technology in Bratislava (STU) as the educational and scientific institution in Slovakia, where 12 000 students attending, consists of 7 faculties - Faculty of Civil Engineering, Faculty of Mechanical Engineering, Faculty of Electrical Engineering and Information Technology, Faculty of Chemical and Food Technology, Faculty of Architecture, Faculty of Materials Science and Technology and Faculty of Informatics and Information Technologies. It offers education mainly in technical, technological, technical-economical, technical-information and technical-artistic fields of study using the modern methods of education, laboratories and practical training. It is aimed at the study branches with stable opportunities of students' employment at the labour market.

The University of Economics in Bratislava (EUBA) consists of 7 faculties as well with the most relevant the Faculty of Economic Informatics, the Faculty of Business Management, Faculty of Commerce and the Faculty of National Economy. The vision of the university is to be perceived and recognised as a modern and dynamic university comparable to major and generally respected institutions of high education and of similar professional orientation at least in the region of Central Europe, with a high professional and scientific level, reflecting the social responsibility, which manifests in the concrete projects of cooperation with institutions and organisations in Slovakia and abroad.

Technology centres in region:

- University Scientific Park for Biomedicine Bratislava (BioMedPark) as the largest research centre of its kind in Slovakia with capacity for approx. 500 scientists. The park offers modern laboratories, staff and centre management centres as well as technology and knowledge transfer. Its' goal is to build an instrumentation base for research at a level comparable to many major centres in the world. Its goal is to improve collaboration among the team, to create a motivating environment for young scientists. The park will create a platform for technology transfer, link science, research and innovation to the business sphere, and have the potential to become a breeding ground for identifying potential spin-off companies. Moreover, the Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that SMEs, are strong innovators comparing to the EU-average and innovation performance has increased significantly over time. The most visible activities are the Public-

private co-publications and International scientific co-publications, SMEs innovative collaborating, SMEs innovation in-house, as well as tertiary education and lifelong learning.

- University Scientific Park „ Campus MTF STU “ – CAMBO which consists of 2 main laboratories. In the first one there is a ionic and plasma technologies laboratory which allows scientists to modify materials by using a stream of ions up to 6 million volts or to modify the surface of the materials also by plasma interaction, coating or sputtering. The second laboratory is equipped with technology of leading world producers with emphasis on manufacturing processes in automotive industry. The department will serve for applied research and training for students for their praxis.
- STU Research centre Allegro with aim to ensure a stimulating environment for research and appropriate conditions for addressing interdisciplinary projects and implementing the outputs for technology transfer. It aims to address the safety and reliability tasks of existing nuclear power plants, used nuclear fuel storage, nuclear waste disposal and decommissioning of nuclear material. The centre is solving existing problems related to the operation of nuclear facilities as well as the secure education of a new generation of specialists.
- Comenius University Scientific Park (CUSP) concentrating on biomedical, environmental and biotechnology, technology transfer centre. Other part of the park is the Incubator of the CUSP in which supports knowledge based on the transfer of the science and technological outputs from the university into the companies and especially into the start-ups and spin-offs, research outputs on the needs of the established companies with the aim to enhance their innovativeness and competitiveness on the market, innovative start-ups and businesses stimulation. It also specialises at dynamically growing companies – start-ups support with the high grow potential as well as create cooperation and partnership with regional and international organisations, institutions and companies with the aim to fulfil these objectives.
- HubHub is centre designed with aim to create and maximise opportunities between people and the wider ecosystem, and for educational programmes to develop and grow talent. It is operating networking events to foster chemistry between the potential partners, collaborators, VCs and investors, and offer access to the kind of support, talent and skill-sets.
- Campus 0100 is an international co-working area for entrepreneurs, freelancers, students etc. Currently it hosts 70 start-ups, and 140 members.
- Impact Hub Bratislava is a co-working space with unique value proposition by operating coworking facilities in Bratislava; offering professional services for individuals and businesses; creating and delivering practical programs; and organising meaningful and inspiring events. The co-working supports development of startup ecosystem in Slovakia and brings several new i.a. launched a third edition of Impact Incubator – most complex incubation program addressing Tech for Good & Social Projects and start-ups in Slovakia. The community managed to build diverse and growing community of members and supporters.

- The Slovak Alliance for Innovation Economy (SAPIE) is the largest innovative alliance in Slovakia. It is a leading forum for debate on digital economy and innovation in Slovakia consisting of independent and non-profit platform connecting more than 60 innovative companies. The aim is to support initiatives that help to increase the reach of digital education, entrepreneurship and creative skills among students, teachers and parents. These initiatives have the potential to close the gap between the 'haves' and the 'have-nots' of digital economy and help to create an innovation-friendly culture.

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. The main points of economic development areas are:

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- **Production and processing of iron and steel**, The development of technological investment units, particularly in the fields of metallurgy, engineering, energy and integrated industrial equipment, with regard to the application and use of light metals and modern materials in the production of transport and construction techniques.

Demand-side barriers regarding the implementation of digital transformation

One of the structural problems in the whole Slovakia is its low level of enterprises' digitalisation. Deputy Prime Minister's Office for Investments and Informatisation of the Slovak Republic as the major authority is responsible for spreading the unified digital market strategy, national concept of public sector informatisation and the technical support of projects. Although the informatisation process has already been launched the digitalisation in both public and private sector is behind the estimated time schedule. The objectives of the Digital Agenda for Europe by 2020 is the introduction and operation of fast broadband at min. 30 Mbit/s for EU citizens by 2020.

There is also a task concerning minor opinion about digital skills improvement of population. In order to change the population mind-set the education and competency to use modern technology, even for the part of population who do not

have enough financial resources to buy such technologies is very important as part of IT inclusion.

As to the huge IT transformation projects in the private sector there can be seen a complication in its financing and decision-making competencies. The most visible lack of decision-making power is at local management level where the standard IT implementation projects are dependent upon approval of its headquarters. Current situation already prolongs the implementation of new IT software solutions and well as possible enforcing of local software service providers.

The Bratislava region is considered as the most developed and prepared region for digital transformation initiatives.

In order to implement and develop digital transformation in the other regions, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for value added creation and servitisation, attracting external and foreign funding to leverage investment risks.

Structural macro-economic barriers

A frequently changing legislative environment makes it difficult and costly for companies to comply with legislation, and legislative and regulatory processes are often viewed as insufficiently business-friendly. The lack of eGovernment services complicates business interactions with authorities. Perceptions of corruption and favouritism are rife, especially in public procurement.

The justice system in Slovakia continues to face challenges with regard to its overall effectiveness. While efficiency has started to increase, the workload of the courts remains high.

The regional GDP in Bratislava region is approx. 22,8 m EUR which means 28% of Slovak GDP. Concerning the population in region the GDP per capita is almost 240% of average national GDP. The main success factors are i.e. the location of international companies with significant value added as well as headquarters of many manufacturing companies situated in other regions.

Bratislava region is not affected by regional disparities caused by lack of adequate infrastructure, investments in education and further research and development, Despite these factors there still is some brain-drain and workforce movements abroad mostly for the financial benefits or the personal versatility efforts. Despite one of the highest ratio of rural population there is a significant need of commuting due to workforce demand in the city as regional and national centre. The situation is slightly more visible in last 5-10 years where workforce and students of almost 200 000 people are commuting to Bratislava on a daily basis according to SIM location and big data usage.

Bratislava region has one of the lowest unemployment rates of 3.05% in 2017, which is almost 3 percentage points lower than the national unemployment rate in Slovakia. The situation is very similar to previous years when the ratio stays under national

unemployment rate in Slovakia. There is also a brain-drain issue when talking mainly about self-realisation goals or favourable remuneration conditions in close abroad regions especially in Austria. There are some government and third sector initiatives to prevent those emigrations such as LEAF organisation that assists Slovaks when moving back from abroad and contribute to a better quality of life. The labour costs increase tries to copy the market situation in region. Despite it still does not fully comply with lack of adequate educated labour force and the free labour market.

Infrastructural underdevelopment is a fundamental development barrier for the region industry. There are more motorways and highway by-pass which will conduct municipalities under preparation and some of them will be under construction hopefully in coming years. There is also a strong pressure on integrating the train transportation into the integrated traffic system combining with the other intra-city vehicles (car parking lots, trains, trams, bus) to relieve the daily traffic jams in the city.

Sources of available public finance for innovation projects

Bratislava region is the most developed region in Slovakia and it is excluded from most of the EU funding. However, it has its own Operational Program Bratislava Region financed by the European Regional Development Fund (ERDF). This operational program focuses on innovation, technological transfers, and informatisation of society among other agendas.

Commercial firms as well as not-for profit institutions can receive funding on the European level from the largest EU research and innovation program Horizon 2020.

Public funds are also available through microfinancing schemes where small companies can receive up to 50 000 EUR with an interest rate starting at 0,61%. Funding is available through both public and non-governmental bodies supported by governmental structures.

Sources of private sector finance for innovation projects

Start-ups in their early stages have access to private funding through business angel investors. A platform that brings such investors together is called Slovak Business Angels Network and young start-ups can approach potential investors here.

More mature start-ups can get financing via venture capital funds. Venture capital market has been growing in Slovakia during past years quite significantly. Start-ups in Bratislava region can find opportunities for venture capital funding for example at Neulogy Ventures, Národný holdingový fond (National Holding Fund), Fond inovácií a technológií (Innovation and Technology Fund), Slovenský rozvojový fond, a.s. (Slovak Development Fund), or Slovenský rastový kapitálový fond (Slovak Capital Growth Fund).

Bratislava region is the most developed region in Slovakia regarding business accelerators and incubators. They provide mentoring services, professional consulting and premises on top of funding. The most relevant incubators and accelerators in Bratislava region are HubHub, The Spot, Impact Hub, or University Technology Incubator of STU – InQb. The last one is also a Digital Innovation Hub supported by the Smart Factories project.

Financial support of innovation is not only available for start-ups. Established companies can of course receive funding from banks and from private equity funds such as ARX Equity Partners, Enterprise Investors, Genesis Capital, s.r.o., or Limerock Fund Manager.

Positive and negative examples of initiatives undertaken in the region

Initiatives regarding innovation and digitisation have rather national than regional character. Below are few examples of such initiatives.

Google runs a non-profit initiative called Digital garage. Goal of this initiative is to teach individuals digital skills to enhance their businesses or carriers. Digital Garage introduces learners to different tools and teaches them how to utilise their full potential. Everything is in a form of interactive online courses.

There is also governmental initiative called Digital Coalition. Its goal is to popularise topic of digitisation in Slovakia. In order to do this, Digital Coalition brings together public, private, and academic institutions. Each member has to formulate his commitment. We will have to wait to see these commitments to come to practice.

The number of women studying IT in Slovakia used to be as low as 3-5% of all IT students in Slovak universities in 2012. Initiative Aj ty v IT tackles this problem by trying to increase interest in IT in Slovak women. The initiative organises events, provides support, and runs programming academy. They have set a goal that there will be 30% of female students on IT faculties in Slovakia.

The Slovak Alliance for Innovation Economy (SAPIE) is the largest innovative alliance in Slovakia. It is a leading forum for debate on digital economy and innovation in Slovakia consisting of independent and non-profit platform connecting more than 60 innovative companies. The aim is to support initiatives that help to increase the reach of digital education, entrepreneurship and creative skills among students, teachers and parents. These initiatives have the potential to close the gap between the 'haves' and the 'have-nots' of digital economy and help to create an innovation-friendly culture.

2.2.12.3 Žilina

Žilina self-government region is located in the north-western part of Slovakia bordering with The Czech Republic in the west and Poland in the north. The biggest cities in the region is Zilina (as the self-governing regions is named). The region is historically famous for industrial companies from which most of them were transformed and exist until now.

According to Slovak Business Agency, there were 76 199 SMEs in Žilina region from which approx. 97.3% were defined as active micro-enterprises in 2017. The centre of business activities was district of Žilina with concentration of approx. 27.5% of all SMEs. The most frequent are SMEs in the field of services (32.5%), important are also the construction SMEs (25.4%) and industry SMEs (16%). The 8 447 newly established SMEs i.e. increase of 6.5% SMEs in the region compared to the year 2016. On the other hand, there were also 7 360 SMEs termination in 2017 when almost a third were construction SMEs. The entrepreneurship gender structure shows the huge dominancy of male entrepreneurs with 76% as the second biggest ratio in the whole Slovakia. The positive indication is seen in the biggest ratio 19.1% of young entrepreneurs under 30. On the other hand, there is the lowest amount of elderly entrepreneurs over 60 with ratio of 8.3%.

Žilina region is adequately connected by motorway and highway network. The D1 highway from Western Slovakia is fully constructed and in present ends in city agglomeration of Žilina and continues through the city. Afterwards it also passes the critical section down the Dubna skala mountain with the small part of highway in operation finishing by Martin town. There is also a short D3 highway section as a

Žilina north-west by-pass continuing to the Kysuce region and Poland. Other motorway and highway network especially main northern corridor to Poland as well as the tunnelling of D1 in Dubna skala mountain is under preparation or construction phase when the final deadlines are yet postponed by years. As to the railway transport, both cities are connected by the express trains and fast trains as from the main railway corridor from Western to Eastern Slovakia. There is also a small regional airport in Žilina used mainly for private flights purposes or for charter flights during the holiday season.

Žilina could be considered as the students' city with the University of Žilina (UNIZA), UNIZA specialises in more industry and digitalisation fields in the Faculty of Electrical Engineering, the Faculty of Management, Science and Informatics, the Faculty of Civil Engineering, the Faculty of Security Engineering or the Faculty of Operations and Economics of Transport and Communications. The university has over 7 500 students.

Technology centres in region:

- Centre for Applied Research of New Materials and Technology Transfer with focus on applied research on new materials and technologies and building a technology transfer platform. The centre includes research laboratories for ceramic or metallic materials, nanomaterials as well as a technology transfer office and an incubator for prospective industrial projects.
- University Science Park at the University of Žilina is a development of an excellent and internationally recognised Science Park with the principal focus on economic growth and regional development. It focuses on innovation culture increase, extensive support of applied research and knowledge transfer into practice, regional knowledge-based, innovation development as well as research and development in the field of intelligent transport and manufacturing systems. Apart from that, it also makes research in field of progressive materials and technologies as optical fibres and photonic elements or biomedical engineering and also in information and communication technologies.
- Research centre at University of Žilina with aim to achieve synergic effect in using and enhancing research potential by integrating crucial research activities as Regional Centre for applied research. Its primary goal is to create the environment encouraging acceleration and integration of innovative research activities of the University of Žilina as well as the swift implementation and commercialisation of research outcomes. Activities will directly contribute to economy competitiveness increase of Žilina region, as well as the Euro-region Beskydy and regional disparities decrease throughout the whole Slovak Republic. The focus areas are transportation including control, operation and new materials, construction, mechanical engineering and smart systems, mainly focused on smart buildings operation and renewable energy sources.
- Biomedical centre Martin as a modern, dynamically developing centre focused on applied research and facilitates interaction between the academic environment and its researchers and the business environment. It is primarily divided into divisions of molecular medicine, neurosciences, oncology and respirology.

Moreover, the Regional Innovation Scoreboard from 2017 conducted by the European Commission shows that SMEs, are relative equal to EU-average with respect to innovation-collaboration and in-house innovations.

The EU has created a program for a regional innovation strategy of smart specialisations (RIS) with the aim to create knowledge-based jobs not only in leading research and innovation hubs but also in less developed areas. The main points of economic development areas are:

- **Automotive and mechanical engineering industries** with increasing the value added of domestic products, in particular by transferring technology and the results of science and research into the production process, energy efficiency and renewable energy sources. Development of technological investment units, particularly in the field of energy and industrial facilities, with a view to internationalisation of activities and development of "Emerging countries"
- **Consumer electronics and electrical equipment.** The development of industry-friendly manufacturing practices geared to better use of available resources, higher recycling rates and the use of environmentally friendly materials through the use of science and technology development and innovation. "
- **Information and communication technologies and services**, which goal is to create new solutions in usage of robotics and ICT in production processes. Companies will be able to streamline production and logistics processes that will result in total energy intensity reduction and in the implementation of information and communication technologies in intelligent applications in industry.
- **Production and processing of iron and steel**, The development of technological investment units, particularly in the fields of metallurgy, engineering, energy and integrated industrial equipment, with regard to the application and use of light metals and modern materials in the production of transport and construction techniques.

Demand-side barriers regarding the implementation of digital transformation

One of the structural problems in the whole Slovakia is its low level of enterprises' digitalisation. Deputy Prime Minister's Office for Investments and Informatisation of the Slovak Republic as the major authority is responsible for spreading the unified digital market strategy, national concept of public sector informatisation and the technical support of projects. Although the informatisation process has already been launched the digitalisation in both public and private sector is behind the estimated time schedule. The objectives of the Digital Agenda for Europe by 2020 is the introduction and operation of fast broadband at min. 30 Mbit/s for EU citizens by 2020.

There is also a task concerning minor opinion about digital skills improvement of population. In order to change the population mind set the education and competency to use modern technology, even for the part of population who do not have enough financial resources to buy such technologies is very important as part of IT inclusion.

As to the huge IT transformation projects in the private sector there can be seen a complication in its financing and decision-making competencies. The most visible lack of decision-making power is at local management level where the standard IT implementation projects are dependent upon approval of its headquarters. Current situation already prolongs the implementation of new IT software solutions and well as possible enforcing of local software service providers.

In order to implement and develop digital transformation in the Žilina region, similarly to other regions, all entities should contribute to growth, upscaling and internationalisation of SMEs by involving them in joint R&D and innovation ventures, as well as integrating them into value chains of large enterprises, providing access to markets and facilitating private and public investments. In order to do that, there should be a developed user-driven innovation environment based on digital technologies, ranging from the Internet of Things, big data analytics, and simulation environments to rapid prototyping, and additive manufacturing. This would foster trust and enable open value networks as well as educate the market on how to absorb digital tools for value added creation and servitisation, attracting external and foreign funding to leverage investment risks.

Structural macro-economic barriers

A frequently changing legislative environment makes it difficult and costly for companies to comply with legislation, and legislative and regulatory processes are often viewed as insufficiently business-friendly. The lack of eGovernment services complicate business interactions with authorities. Perceptions of corruption and favouritism are rife, especially in public procurement.

The justice system in Slovakia continues to face challenges with regard to its overall effectiveness. While efficiency has started to increase, the workload of the courts remains high.

The regional GDP in Žilina region is approx. 8,9 m EUR which means 11% of Slovak GDP. Concerning the population in region the GDP per capita is 86% of average national GDP.

The region is affected by regional disparities caused by lack of adequate infrastructure, investments in education and further research and development. Despite these factors there still is some brain-drain and workforce movements mostly from less developed areas. In spite of one of the highest ratio of rural population there is a significant need of commuting due to workforce demand in the cities as local and regional centres.

Žilina region has quite low unemployment rate of 4,7% in 2017, which is almost 1,3 percentage points lower than the national unemployment rate in Slovakia. There is also a brain-drain issue especially in less developed areas in both regions as there are some government and third sector initiatives to prevent those emigrations such as LEAF organisation that assists Slovaks when moving back from abroad and contribute to a better quality of life. The labour costs increase is most visible in the big cities with lack of adequately educated labour force.

Infrastructural underdevelopment is a fundamental development barrier for the industry of these regions. More motorways are under preparation and some of them are hopefully going to be under construction in coming years in order to connect the municipalities.

Sources of available public finance for innovation projects

A high-level research of available public financing of innovation and digitisation in Žilina region have shown that such funding is based almost exclusively on funds from the EU.

The most significant source of public finance from the Structural funds is the Operational Program 2014 – 2020 Research and Innovation. Ministry of Economy of

the Slovak Republic and Ministry of Education, Science, Research and Sport of the Slovak Republic administer this program together.

Financial coverage of the operational program has been set at 2 266 776 537 EUR by the European Commission. There are three types of calls for proposals available in this program.

1. Demand-oriented projects

Small and medium sized enterprises as well as research institutions can apply for demand-oriented projects.

Examples of past calls for proposals:

- Support of creation and activities of technological innovation platforms within individual economic sectors
- Encouragement of SMEs to join EU programs
- Support of innovation through industrial research and experimental development with the Digital Slovakia and Creative Industry domain
- Support of innovation through industrial research and experimental development with the Industry for 21. century domain

2. National projects

National project is a project with focus, character of activities, geographical reach, and other attributes that tackles areas with national impact in complex and systemic way. A beneficiary based on donor's request realises national project.

Examples of call for proposals:

- Support of creative industry development in Slovakia
- Support of internationalisation of SMEs
- Increase of innovation performance of Slovak economy

3. Financial instruments

Intention of implementation of financial instruments is to provide financial resources in areas of technological development, innovations, research and development, and competitiveness. Financial instruments can take form of loans, guarantees, venture capital, and other forms of capital financing.

Calls for proposals were directly addressed to selected institutions.

The Interreg Europe programme, financed by the European Regional Development Fund (ERDF) is designed to support knowledge sharing among policy organisations among different regions. The program does not support commercial firms. However, public authorities, regional development agencies, business support organisation, universities, or private non-profit bodies are eligible for Interreg funding. The program's focus topics are:

- Research, technological development and innovation
- Competitiveness of SMEs
- Low-carbon economy
- Environment and resource efficiency.

Commercial firms as well as not-for profit institutions can receive funding the European level from the largest EU research and innovation program Horizon 2020.

Public funds are also available through microfinancing schemes where small companies can receive up to 50 000 EUR with an interest rate starting at 0,61%. Funding is available through both public and non-governmental bodies supported by governmental structures.

Sources of private sector finance for innovation projects

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Incubators in Žilina region provide mentoring services, professional consulting and premises on top of funding. The most relevant incubators and accelerators in Žilina region are Zintech, Entrepreneurial Incubator Handlová, Municipal Incubator Martin, and Technological Incubator VTP Žilina.

Financial support of innovation is not only available for start-ups. Established companies can of course receive funding from banks and from private equity funds such as ARX Equity Partners, Enterprise Investors, Genesis Capital, s.r.o., or Limerock Fund Manager.

Positive and negative examples of initiatives undertaken in the region

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of digital education, entrepreneurship and creative skills among students, teachers and parents. These initiatives have the potential to close the gap between the 'haves' and the 'have-nots' of digital economy and help to create an innovation-friendly culture.

2.2.13 Slovenia

Slovenia's digital transformation performance displays wide variations featuring strong points and significant challenges. Slovenia is a strong performer in e-leadership and ICT Start-ups; yet, the unfavourable investment climate and low entrepreneurial culture remain key challenges for the country. Compared to other EU Member States, Slovenia scores above the EU average in three out of seven dimensions. Notwithstanding existing challenges, the Slovenian government is implementing measures at strategic as well as operational levels to drive forward its digital transformation.

The crisis has revealed a number of structural weaknesses, particularly the fact that GDP growth in Slovenia is too dependent on low technology industries and traditional services, which limit the competitiveness of the economy. In these harsh conditions, Slovenia has to focus on raising the cohesiveness of society and competitiveness of its economy while consolidating and restructuring its public finances. For this, Slovenia is relying on creativity and knowledge, which are fundamental values and the sources of the country's future wealth.

Slovenia is a strong performer in the field of e-leadership and ICT Start-ups. Its high performance in e-leadership is matched with a rather average score in the supply and demand of digital skills indicating that companies provide good training opportunities to a rather low number of ICT specialists. An additional field where Slovenia shows a good performance is digital infrastructure. Judging on the basis of the rather low performance of the country in integration of digital technology, it appears as if Slovenian enterprises did not make good use of the good digital infrastructure. Despite its good performance in ICT start-ups, Slovenia performs the lowest in the field of entrepreneurial culture. Furthermore, Slovenia scores low in investments and access to finance.

Structural macro-economic barriers

Compared with other EU member states, Slovenia has been recording about a fifteen-year long downward trend in its information society development level, which has reflected negatively in other development areas. This situation is a result of significantly too low investments in the development of information society, and insufficient general awareness of the importance of ICT and the internet for the development of the economy, state and the society in general. European competitors have made higher and more systematic investments all this time, which reflects in faster development progress than Slovenia was able to implement. By inappropriate placement of ICT and the internet in its development efforts, Slovenia as a society forgoes the development potentials enabled by ICT and the internet. If such practice does not stop, the development lag behind the countries that place the highest priorities on these areas will continue.

The latest data on the indicators of development and comparisons in the EU framework are alarming. The development lag grows from year to year, so Slovenia needs to change the social attitude towards ICT and the internet at the threshold of the new development period until 2020 and create a more stimulating environment for the faster and more harmonised development of an information society and the

ICT sector. To this end, Slovenia needs to provide considerably higher development funds in order to reduce the development gap with the most developed countries in the following development period until 2020 as much as possible. The progress in higher competitiveness of the ICT sector, development of digital society, digital economy and, last but not least, digital growth will not be possible without thorough changes in the awareness of the importance of ICT and the internet in Slovenia.

The below-given table summarises the key strengths, weaknesses, opportunities and threats (SWOT analysis) of Slovenia's economic, research and development innovation system. The relevant strengths, weaknesses, opportunities and threats

SWOT analysis of Digitalisation of Slovenia

Strengths

- Diversified economic structure - potential in terms of complementarity and the provision of integrated solutions
- High level of research and development activity (RDA) in the business sector.
- Good research and development (R&D) capacity and potential in the public sector
- Strong involvement of Slovenian stakeholders in international value chains and networks
- High productivity of well-managed companies, including subsidiaries of multinational companies in Slovenia, in particular those with preserved function of development
- Areas of excellence in academic and industrial research
- Educated labour force, language skills and willingness to learn
- Comparatively intensive research, development and innovation (RDI) policy over the past 15 years and a stimulating tax environment for RDI
- Well-developed infrastructure/internet accessibility. –
- High-quality living and working environment, and resources for the transition to green economy:
 - security
 - clean and healthy living environment, preserved
 - biodiversity, natural resources
 - developed tourist infrastructure and tradition and

Weaknesses

- Diversified economic structure fragmentation, lack of critical mass and relative absence of strong economic systems
- Over-indebtedness of companies and often unstable ownership structure with the absence of strategic shareholders, including foreign investments
- Share of budgetary resources and public expenditure for RDA, and a significant gap between R&D expenditure of the public and business sector
- Public funding and RDI management model
- Commercialisation of knowledge and technologies
- Low level of internationalisation of science and higher education. - Innovation-related activity and performance of companies
- Despite the extensive scope of inventions the transition to innovation is not sufficient due to:
 - Weak development departments in companies, Weak cooperation (a) between knowledge institutions and the economy; (b) between companies; (c) between knowledge institutions,
 - Partiality and incompleteness of the supportive environment and development incentives which (a) do not address in a systematic manner the entire development cycle (through technological levels), (b) are overly-fragmented in terms of content, (c) do not cover integrated support and (d) are time-wise unpredictable and unstable o
 - Fragmentation of support institutions lacking sufficient critical mass

Threats

- Brain drain, in particular of young people, the educated, those having entrepreneurial spirit and possessing experiences, within the economy as well as knowledge institutions and public administration, with the ageing of the population being an issue as well
- Capital flight, redirected investments and departure of companies to other regions and countries
- Enhanced responsiveness, adaptability, activity with our competitors
- Domination of neighbouring economic and knowledge centres (Graz, Udine, Zagreb, etc.)
- Compared to our competitors the quality of infrastructure poses a threat: e.g. ICT infrastructure as well as rail and road infrastructure (risk of a declining accessibility of Slovenia as an economic, logistic and tourist location)
- Perception of Slovenia as a peripheral, non-competitive and rigid country which is investment and talent unfriendly
- Focusing individual activities on existing location

Opportunities

- Reorganisation of international value chains and new industrial revolution:
 - Opportunities to establish a stronger position within higher level value added (VA) value chains
 - Global uncertainty may enhance the attractiveness of locations that are closer to end markets
 - Opportunities to attract foreign investments, namely to enhance the existing and attract new foreign investments, in particular through knowledge-intensive activities (development departments)
 - Brain circulation and attracting foreign talents.
- Green jobs and material and energy efficiency in relation to the use of natural resources, water management biodiversity and traditional knowledge
- Strengthening integration instruments at the EU level
- Cross-border complementary linkages with the specialisation of neighbouring economic and knowledge centres \ synergies for mutual benefit
- Accessibility/location: proximity of strong economies, innovation leaders
- Visibility in terms of well-preserved nature, cultural heritage and offer, gastronomy and other traditional activities and the extraordinary achievements of individuals (e.g. in sports, culture)
- Further opening up of markets among major world trading blocks and traditional presence of Slovenian stakeholders in certain emerging markets (Southeastern Europe, Russia, Middle East, etc.)
- The small size of Slovenia and proximity of stakeholders (Slovenia as a reference country).of procedures and non-supportive tax environment for entrepreneurship

Source: Slovenia's Smart Specialisation Strategy, 2015

Smart specialisation is a platform for concentrating development investments in areas where Slovenia has the critical mass of knowledge, capacities and competences and where there is innovation potential for placing Slovenia within global markets

and thus enhancing its recognisability. Smart specialisation is a strategy aiming to: a) strengthen the competitiveness of the economy by enhancing its innovation capacity b) diversify existing industries and service activities c) boost growth of new and fast-growing industries and enterprises S4 is an implementing document relating to the already-adopted strategic documents.

S4 addresses all four objectives set under the existing Slovenia's Development Strategy for the 2006-2013 period which pertain to establishing an "innovative knowledge society" for which Slovenia has already identified three key field-specific strategies, namely the Research and Innovation Strategy of Slovenia 2011-2020 (RISS), Slovenian Industry Policy (SIP) and Digital Agenda, as well as other specific and relevant strategies in the field of nature protection, energy, education, etc. Slovenia's guidelines are thus integrated and outlined in a more concrete manner within a single and a consistent framework facilitating the implementation of focused and synergistic measures.

Development Strategy for the Information Society until 2020 specifies strategic directions of the digitisation of society and business, which will form the foundations of development projects by priority areas of the SSS. It foresees measures for harnessing the social and economic potential of ICT and the internet for digital growth, focusing on digital infrastructure, intense use of ICT and the internet, cyber security and an inclusive information society.

The DIGITAL SLOVENIA strategy is a commitment for a faster development of the digital society and the use of opportunities enabled by information and communication technologies and the internet for general economic and social benefits. Along with the strategies from its scope, it envisages measures to tackle the major development gaps in the field of digital society: faster development of digital entrepreneurship, increased competitiveness of the ICT industry, overall digitisation, development of digital infrastructure, construction of broadband infrastructure, strengthened cybersecurity and the development of an inclusive information society.

Sources of available public finance for innovation projects

It foresees priority investment in the digitisation of entrepreneurship, innovative data-driven economy and development, and the use of the internet and, in these frameworks, in the research and development of technologies of the internet of things, cloud computing, big data and mobile technologies

Since 2010, coordination of policies in Slovenia has been performed by the Umbrella Working Group for Harmonisation and Coordination of Slovenia's Development Planning, who observes Slovenia's Development Strategy, National Development Programme of the Republic of Slovenia for 2007–2013, National Reform Programme for 2008–2010 (Europe 2020) and the budget of the Republic of Slovenia for each financial year. The policies are implemented through the national budget. Competences for research and innovation policy are shared between the Ministry of Higher Education, Science and Technology (MVZT), the Ministry of Economy (MG) and in part by the Government Office for Development and European Affairs (SVREZ) and the Government Office for Local SelfGovernment and Regional Policy (SVRL). The Ministry of Economy implements its programme through the Public Agency for Entrepreneurship and Foreign Investments (JAPTI), the Public Agency for Technological Development (TIA) and the Slovenian Enterprise Fund (SPS). MVZT delegated the implementation of most of its measures to the TIA and the Slovenian Research Agency (ARRS). The subject is also covered by two advisory bodies of the

Government of the Republic of Slovenia, the Council for Science and Technology and the Competitiveness Council. A consequence of the fragmented system of governance of research and innovation is a mismatch between policies and responsibilities and duplication of instruments, as well as poor implementation of the adopted strategic documents, notably the existing National Research and Development Program

The increased extent of tasks and responsibilities and particularly the ambitious planning of development, new instruments and more active participation in the international scientific and innovation environment also increase the responsibilities of the competent bodies in the field of science, technology and innovation. However, this was not followed with the reinforcement of the expert staff at the competent ministries to allow adequate preparation and implementation of the policies, an issue which was highlighted in the inspections performed by the international experts. It is reflected in several lost opportunities, both nationally and international.

Slovenian companies primarily fall into the segment of low and medium technological difficulty, are not sufficiently active in the area of research and innovation and are competitive in the global market mainly in segments with strong competition, which is why they are under strong pressure in terms of prices. Another problem is that within Slovenia's structure of products there is only a small share of finished products, since individual components, segments and processing of products prevails. This means that numerous companies are only able to control individual components of innovation activity, with an emphasis on process and less on product innovation. Another side to this is that the service industry, which represents a large proportion of the Slovenian economy and has an added value of 62% of the total economy, does not use innovation capabilities to a sufficient extent. Innovation opportunities are unrealised in public services such as health care, environment and public administration. Due to inadequate business models and a poor focus on development, most Slovenian companies still operate on the basis of economies of scale, where the main emphasis is on quantity and less on added value. Development possibilities for the Slovenian economy are limited by the potential of marketing Slovenian products and services and the small share of sales to end-customers. The Slovenian economy does not have a sufficient internal market which limits the develop (RISS)

There is a need for the systemic regulation of providing a high level of cyber security and improving financial, human and technical resources for key stakeholders. A series of measures must be implemented to eliminate the largest development lags in the digital society and set up appropriate digital infrastructure for the equal participation of Slovenian stakeholders in the single European digital space. The strategy envisages the establishment of the Slovenian Digital Coalition to unite stakeholders developing the digital economy and establishing digital jobs, as well as other stakeholders of the digitisation of Slovenia.

Working with the private sector, NGOs and other stakeholders, measures will be put into place for the digitisation of entrepreneurship and society, for increased overall awareness of the developmental importance of ICT and the internet, improved digital literacy, improved e-skills of active population, and the increased number of trained ICT professionals. Formal and informal education should be opened up to new ideas and adapted to new generations, the needs of educating for new digital jobs, and the equal participation of all generations in the European digital society. Measures for a better internet for children and the elderly are foreseen. In the digital society of the omnipresent internet and ICT, we must provide a high level of personal data protection and privacy of communication in order to create confidence in the digitisation and cyberspace.

3 Supporting policy measures for the establishment of DIHs in the EU13

The establishment of Digital Innovation Hubs in the EU13 have to be part of wider initiatives to digitalise industry and fully exploit the industrial potential in the selected regions. Regions play an important role in implementing measures to digitise and digitalise their industrial base¹⁶¹. First steps have already been adopted, as they have organised their industrial base in clusters. These clusters gather the local industry actors together with the knowledge institutes, as well as governmental organisations.

National and regional governmental authorities in the EU13 can introduce support measures to help the Digital Innovation Hubs themselves. Even more important, their backing is crucial when it comes to creating incentives for their industry to use the latest knowledge, to access new opening markets, to update their workforce, to attract new talents and to obtain finance for their digitisation plans.

In the EU15, supporting actions for Digital Innovation Hubs are part of wider policy initiatives intended to facilitate digital transformation in Europe. The Digital Transformation Monitor¹⁶² took stock of Industry 4.0 initiatives across Member States and identified the need for systematic cooperation and exchange of good practice amongst Member States. The European Commission undertook a more detailed analysis of the existing 15 Digitisation Industry Initiatives¹⁶³. These initiatives mainly take the form of large-scale digitisation programmes with 50 policy measures or more.

Best practice in support measures to assist Digital Innovation Hubs in the EU15 cannot be one-to-one transferred to the EU13. The EU13 have a different industrial basis than the EU15. Compared to the EU15, the industrial base of the EU13 is characterised by a mixture of branches of multinational corporations and domestic companies with a lower position in global value chains and lower absorption capacity for research results¹⁶⁴. However, similar to the EU15, a vast majority of domestic companies in the EU13 are SMEs. This explains why assistance should be geared towards the small- and medium-sized companies. To illustrate the difference in approach, relevant lessons on advisory services to SMEs are described in a recent study of the Advisory Hub of the EIB¹⁶⁵. This study found that not all SME advisors are perceived equally. Entrepreneurs tend to be more receptive to input from individuals with business experience than those without. They are often sceptical of the benefits of both public and private support programs. In this sense, experienced mentors can have more impact than well-trained and well-intentioned coaches.

¹⁶¹ Digitising European Industry, Progress so far, 2 years after the launch, March 2018, European Commission, doi:10.2759/024187

¹⁶² <https://ec.europa.eu/growth/tools-databases/dem/monitor/content/welcome>

¹⁶³ National Initiatives for Digitising Industry across the EU, DG Connect, November 2017, <https://ec.europa.eu/futurium/en/implementing-digitising-european-industry-actions/national-initiatives-digitising-industry>

¹⁶⁴ Overcoming innovation gaps in the EU-13 Member States, European Technology Assessment Group (ETAG), Directorate-General for Parliamentary Research Services (DG EPRS) of the European Parliament, ISBN 978-92-846-2660-1, March 2018.

¹⁶⁵ European Investment Bank, Market Gap Analysis for Advisory Services under the European Investment Advisory Hub (EIAH) – Phase II, Final Report, PwC, December 2017, <http://eiah.eib.org/publications/attachments/market-gap-analysis-advisory-smes-phase-ii-en.pdf>

Demonstrated by e-Estonia, digitising SMEs alone is not enough to renew the industrial base. Active policies have to be put in place to stimulate the creation of new start-ups. In this context, the European Commission's Digital Single Market initiative Startup Europe is important, as it is designed to connect startups, investors, accelerators, entrepreneurs, corporate networks, universities and the media.

3.1 Identification of successful support measures in the EU15

For this study, we have selected and analysed EU15 policy measures. Based on lessons learned assessment, the results are options for replication in the EU13. To provide relevant information, we have looked deeply into specific policy measures from Digitisation Industry Initiatives in the EU15 and **selected twenty policy measures** covering each of the EU15 – encompassing national as well as regional initiatives. The selection of these support measures is based upon the following criteria:

1. Policy measures aimed at **digitisation of SMEs and start-ups**
2. Policy measures in **digitisation directed towards fostering competitiveness in the less digitised regions**
3. Policy measures for the **establishment of Digital Innovation Hubs**.

The selected policy measures are presented in table below.

Title of measure	Member state/ region	Nature	Relevance for EU13: Key lessons learned	Relevance for EU13: Key options for replication
Skills Bridge	Luxembourg	Skilling measure	1. Whereas a consensus on digital skills and training seems relevant for all participants, most companies underestimate the necessity of non-technical and soft skills training. 2. No matter which size of firm or its nature, continuous support is required at individual level throughout the process.	Companies need to be aware about the risks and opportunities of the economy 4.0 and be responsive; support is provided on a voluntary basis.
Vouchers for digitisation of SMEs	Italy	Vouchers	1. • The programme has confirmed the need to support SMEs with vouchers, even if the limited amount of money is available per voucher 2. The application portal has to be user friendly, to enable applicants to concentrate on communicating their digitisation plans.	For means of replication, regional stakeholder need to conduct an ex-ante analysis and assess local specificities in order to have an overall picture of the economic performance, opportunities and weaknesses as well as actual and missing resources e.g.

Title of measure	Member state/ region	Nature	Relevance for EU13: Key lessons learned	Relevance for EU13: Key options for replication
				financial, skills, infrastructure, actors.
CAP'TRONIC	France	Digital enabler	<p>1. This initiative is governed by a single dedicated body, JESSICA FRANCE, which has more than a decade of experience in providing advisory services specifically to SMEs.</p> <p>2. A mix of private and public support (whether for instance through knowledge or funding), mostly free of charge, also positively influences the outcomes and impact of the measure.</p>	A Digitisation strategy should be in place, which is carried out by an agency, which is fully dedicated to this strategy.
SME Digital Funding Program	Austria	Digital enabler	<p>1. The measure is part of a national digital strategy (Digital Roadmap Austria).</p> <p>2. As the measure is implemented by regional actors, it is well accepted by SMEs on the ground.</p>	Through its international delegation, the Austrian Chamber of Commerce is engaging in experience-sharing activities in other European states and regions.
Go digital	Germany	Digital enabler	<p>1. The measure is embedded in a national digital strategy (Digital Strategy 2025);</p> <p>2. The usefulness of exchanges with research entities are confirmed.</p>	Structure potentially replicable in early phases, but it requires innovative actors. The e-commerce platform offers feasible opportunities.
SME:Digital	Denmark	Digital enabler	<p>1. Carried out by the Agency for Digitalisation.</p> <p>2. Takes into account traditional SMEs but also start-ups.</p>	Developed examples difficult to replicate given the advanced level of innovation of the Danish industry.
Fieldlabs	Netherlands	Digital enabler	<p>1. Solution-oriented cooperation between SMEs.</p> <p>2. Fertile ground for innovation through continuous exchange.</p>	The use of Fieldlabs can be a useful alternative to supporting innovation through direct government funding.
TeSP Programmes	Portugal	Skilling measure	1. Integrated in a national strategy on digital skills (National Digital	Inclusive approach taking into account future work force as

Title of measure	Member state/ region	Nature	Relevance for EU13: Key lessons learned	Relevance for EU13: Key options for replication
			Competences Initiative). 2. Focus on digital skills.	well as existing professionals.
Activa Industria 4.0	Spain	Skilling measure	1. The measure is specifically geared towards the needs of SMEs. 2. Fits into a national strategy for digitalisation.	Well-designed programme in which advisory to SMEs seamlessly follows awareness raising.
Kickstart Digitalisation	Sweden	Digital enabler	1. Swedish Agency for Growth is in charge of digitalisation related topics. 2. Work is being done on regional level through cooperation with local stakeholders.	Establish a network of actors on national as well as regional levels.
Digitalisation of Irish SMEs	Ireland	Funding measure	1. Backed up by the European Investment Bank. 2. Integrated in a national digital strategy.	Exemplifies options for funding.
Thessaloniki Innovation Zone	Greece	Digital enabler	1. Bring together research and innovation with business. 2. The measure is not specifically geared towards traditional SMEs.	Replication possibility in establishing local fertile grounds for innovation based on research entities and universities.
Vouchers for innovation	Finland	Vouchers	1. Fits into a national innovation strategy. 2. Does not concentrates on SMEs.	The initiative requires existing innovative entities and networks.
Industry 4.0 Digitalisation Boost	Denmark	Funding measure	1. Essential elements are the co-financing by the EU Regional Fund, the intensive cooperation of five incubators, and its extensive network of partnerships. 2. The program strengthens innovation through the formation of innovation partnerships that bring together at least three SMEs and one knowledge institution.	The launching of the initiative requires the existence of an extensive network of innovation-focused entities
ERP Digitalisation and Innovation Credit	Germany	Funding measure	1. The provision of fixed reduced interest rates for a 10-year duration successfully stimulates demand for mezzanine-type financing by providing a reliable basis for long-term calculations. 2. To ensure that the programme does not distort competition among banks, customers apply for the	To ensure effectiveness and efficiency of the programme, implementation should be combined with a continuous and transparent evaluation system.

Title of measure	Member state/ region	Nature	Relevance for EU13: Key lessons learned	Relevance for EU13: Key options for replication
			respective loans with their local bank.	To cater for the galloping rise of demand for financing that the programme generates, following an initial incubation period, successful implementation requires the availability of a large capital base, and the deployment of a program structure that is flexible to change.
Innovation vouchers	Sweden	Vouchers	<ol style="list-style-type: none"> 1. The vouchers initiative has been very popular amongst Swedish businesses and renewed several times. 2. The measure is implemented through local networks. 	Update of a measure to respond to businesses' needs and renew it if well-received.
Northern Ireland Innovation vouchers	Northern Ireland (UK)	Vouchers	<ol style="list-style-type: none"> 1. There is a high demand for funding projects implicating SMEs and higher education institutions.. 2. Rapid results can be observed such as new/improved products, better understanding of innovation and its added-value, as well as positive impact on employment. Over time, project objectives become more specific and mid- and long-term goals are set rather than short-term ones. 	Clear objectives and indicators are required and need to be revised regularly.
Digital Boost	Scotland (UK)	Digital enabler	<ol style="list-style-type: none"> 1. Partnership with Business Gateway (Scotland) and Enterprise Ireland. 2. Local workshops carried out in the region. 	The Digital Health Check can be performed in 5 minutes.
Industrial platform 4.0	Catalonia (Spain)	Digital enabler	<ol style="list-style-type: none"> 1. Involvement of regional actors. 2. Successful marketplace for new digital technologies. 	The initiative is embedded in a dynamic environment.
Made different	Wallonia (Belgium)	Digital enabler	<ol style="list-style-type: none"> 1. The need for awareness raising are firmly confirmed during the implementation. 2. The more an event is considered "prestigious", the more participants will attend. The role of the Factories of the Future and Ambassadors is valuable as they 	Need for a targeted communication campaign for awareness raising.

Title of measure	Member state/ region	Nature	Relevance for EU13: Key lessons learned	Relevance for EU13: Key options for replication
			can serve as models for the industrial sector to share industry's experiences with their peers.	
Comiflex	West Sweden (Sweden)	Skilling measure	1. Working out good communication and a trustworthy relationship with project-participating companies as well as training providers is essential. 2. It is important to create procedures for how newly acquired knowledge is utilised, after employees have participated in skills-enhancing efforts.	Platforms for the exchange of information and experiences should be established.
Digitisation and Innovation vouchers	North Rhine-Westphalia (Germany)	Vouchers	1. The success and accordingly demand for vouchers, both innovation and digitalisation, is growing. 2. Goal-oriented nature of the implementation and its straightforwardness is a sine qua non for appreciation by the participating companies.	The preparation of a voucher programme should map the needs of SMEs, which needs continued monitored during implementation of the measure.

Table 3: Overview of selected policy measures in the EU15, relevant for implementation in the EU13

Based on the selected policy measures, we have identified clear trends and replication of measures within the EU15. Relevant measures for the EU13 are policy measures in **skilling measures, voucher systems, digital enablers and funding measures**.

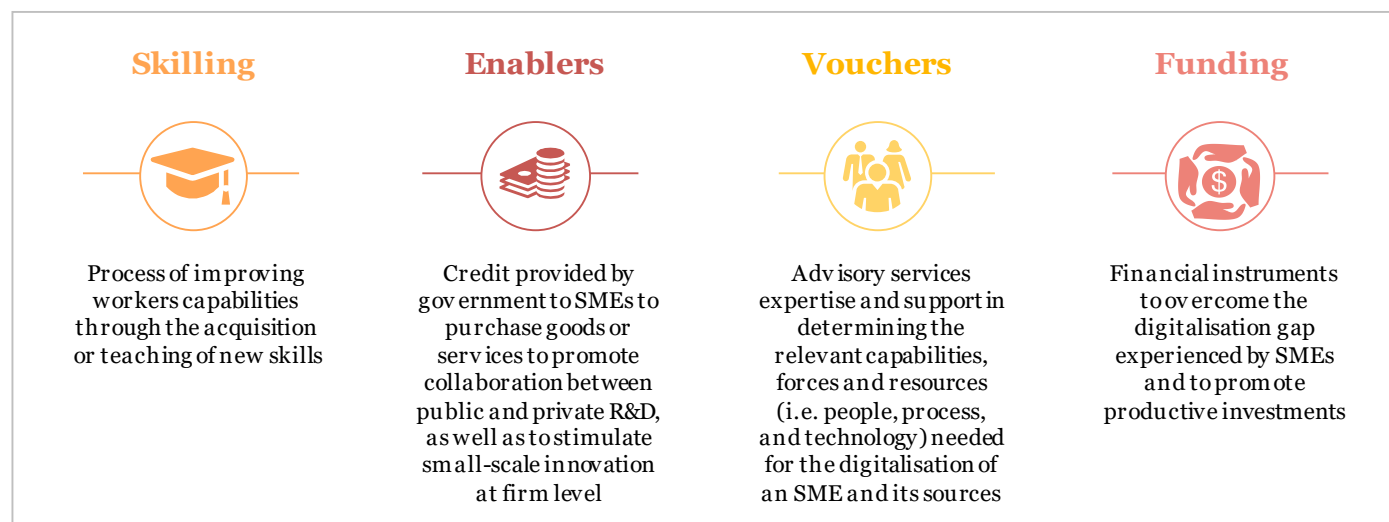


Figure 27: Selected examples of digitalisation measures in the EU15

Skilling measures

At European level, the European Union has taken three upskilling and re-skilling initiatives¹⁶⁶: the Digital Skills and Jobs Coalition, the New Skills Agenda, and the Digital Opportunity Traineeship. These are all initiatives to tackle the shortage of digital skills and are set up to support, to complement or to boost national and regional skills initiatives in member states.

Digital Enablers

In the European market, a mismatch exists between demand and supply of essential digital capacities. To tackle the mismatch digital enablers are implemented at national and regional level in Europe. "Digital Europe"¹⁶⁷ is the answer at European level, which is a proposal for a 9.2bn EUR investment programme within the new framework programme of the European Commission.

Vouchers

Innovation vouchers are used as a policy measure across European Member States and are seen as a well-established part of innovation policies¹⁶⁸. However, their effectiveness in stimulating the adoption of new technologies is hardly documented¹⁶⁹. Due to the need to draw the design of the voucher schemes to local SME needs, the voucher schemes exist mostly at national and regional level.

Funding measures

The development of financial instruments at national and regional level is enabled by the digitisation priorities in the European Structural and Investment Funds. At European level the InnovFin facility of the European Investment Bank is a financial instrument which has the digital economy as one of its priorities, under which it also finances directly Digital Innovation Hubs.

3.2 Best practice of support measures in the EU15

From the listed policy measures, we have further selected the most successful six policy measures on regional and national level. The selection does not include a funding measure, because there is relatively limited information about their impact.

The policy measures selected are:

- Skills Bridge (Luxembourg) – Skilling measure
- CAP'TRONIC (France) – Digital enabler
- Voucher per la digitalizzazione delle PMI / Voucher for digitisation in SMEs (Italy) – Voucher system
- Made different | Digital Wallonia (Wallonia, Belgium) – Digital enabler
- Digitisation and Innovation vouchers (Digitalisierungsgutscheine und Innovationsgutscheine) (NRW, Germany) – Voucher system

¹⁶⁶ Digital Innovation Hubs Working Group, Report from the Working Group Meeting on Digital Skills, July 2018, DG CONNECT, <https://ec.europa.eu/digital-single-market/en/news/report-fourth-meeting-working-group-digital-innovation-hubs>

¹⁶⁷ European Commission - Press release, EU budget: Commission proposes EUR 9.2 billion investment in first ever digital programme, Brussels, 6 June 2018, http://europa.eu/rapid/press-release_IP-18-4043_en.htm

¹⁶⁸ Lessons from a Decade of Innovation Policy, Final Report, European Union, June 2013

¹⁶⁹ Paola Valbonesi, Federico Biagi; Incentivising Innovation and Adoption of ICT: ICT Innovation Voucher Programmes; JRC Science for Policy Report EUR 28293 EN; doi:10.2791/225970

- Competence, Innovation and Flexicurity (Comiflex) (West Sweden, Sweden) – Skilling measures.

Each of these policy measures is described in more detail in the following paragraph, providing details on the reasons for their success and their differentiating factors.

3.2.1 Skills Bridge (Luxembourg) – Skilling measure

Luxembourg Digital Skills Bridge is a national initiative providing technical and financial assistance to upskill employees in companies facing major technological disruption whilst helping firms to better anticipate and adapt to emerging technologies. It is a government-led pilot initiative with a budget of 12M EUR and implemented through the Ministry of Labour, Employment and the Social and Solidarity Economy. The project was launched as pilot in May 2018.

The Digital Skills Bridge programme intends to develop a comprehensive national strategy as well as a support mechanism to ensure the skills development of national workforce and assist companies in their digitalisation undertakings. The governance is ensured by a committee, the so called “Comité de conjuncture,” a tripartite official body gathering representatives from the administration directly involved in the project; representatives of employer associations and trade unions. The committee is co-chaired by the Minister of Labour, Employment and the Social and Solidarity Economy and the State Secretary for Economy. The Skills Bridge Toolbox targets its three partners: companies, employees and social partners and the government, illustrated in the figure below.

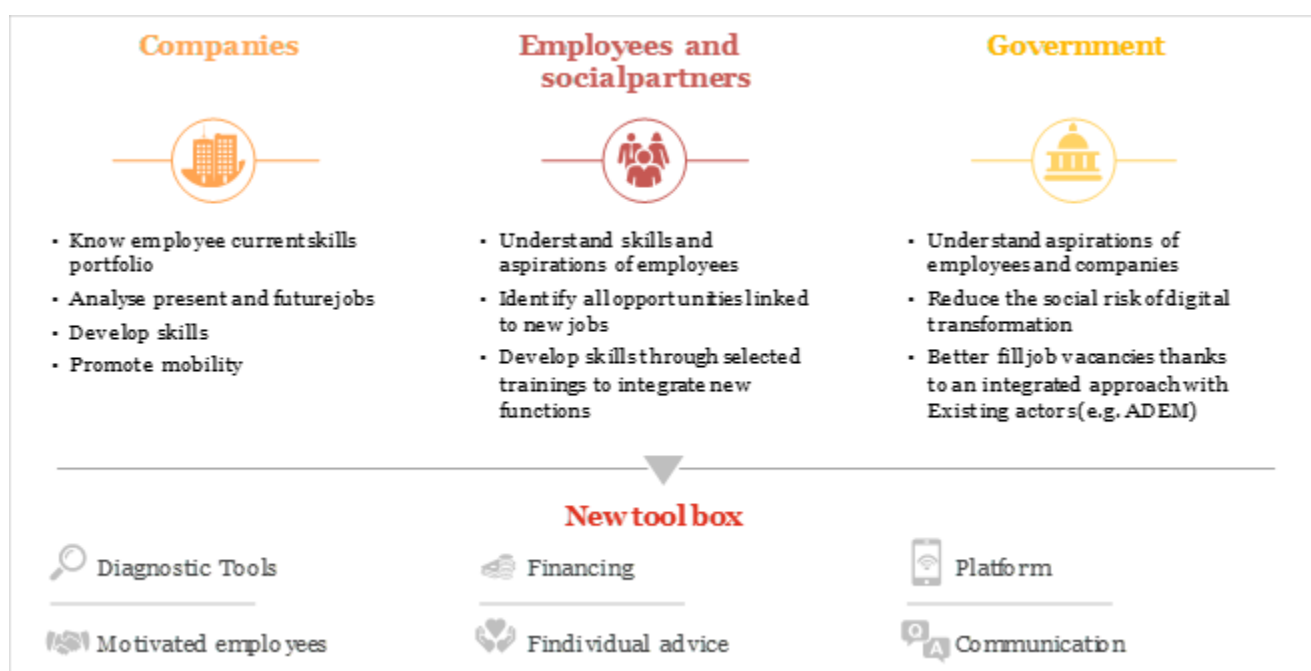


Figure 28: Building a toolbox to facilitate upskilling and workforce mobility

The Skills Bridge initiative encompasses five key result-oriented actions:

1. Raising awareness amongst companies and support those whose business activities will be significantly impacted by digital disruption

2. Coach and upskill employees as well as advise them on new placement opportunities (internal and external mobility)
3. Achieve a 70 % training rate and new job placement of participants
4. Show the value of a proactive and preventive upskilling approach for companies, employees, and society
5. Develop an ecosystem of relevant assessment and upskilling solutions.

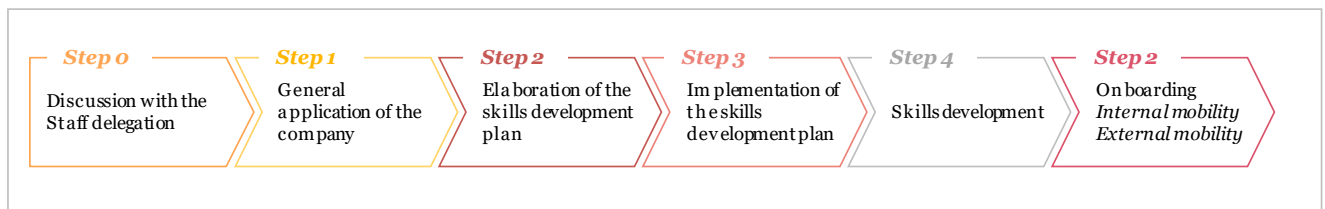


Figure 29: The Skills Bridge process in a nutshell

Skills Bridge does not specifically target SMEs, but in general businesses in Luxembourg. These have to fulfil the following eligibility criteria: the company is introducing a significant technological change to the business, is anticipating change, has consulted the staff delegation (which has given its agreement), must be present and invest in Luxembourg showing its long-term engagement, and must present a result-oriented application including mobility and impact.

The technical and financial support can take the form of:

1. Technical assistance for workforce planning and employee assessment (max. 12 days per company)
2. Individual coaching (1 day per employee)
3. Training cost per employee (reimbursement on invoices); and salary costs during the training covering 90 % of the employee's salary with a limit of 250 % of the minimum wage (which is treated as a temporarily partial unemployment benefit).

Skills Bridge's goal is to develop competencies of the labour force to better anticipate and adapt companies to emerging technologies. In addition, it intends to address a number of skills-related issues affecting the economy, such as the high cost of recruitment the lower productivity and missed growth opportunities related to high and low skilled job remaining unfulfilled as well as the introduction of new technologies that will raise social risks for low-skilled workers.

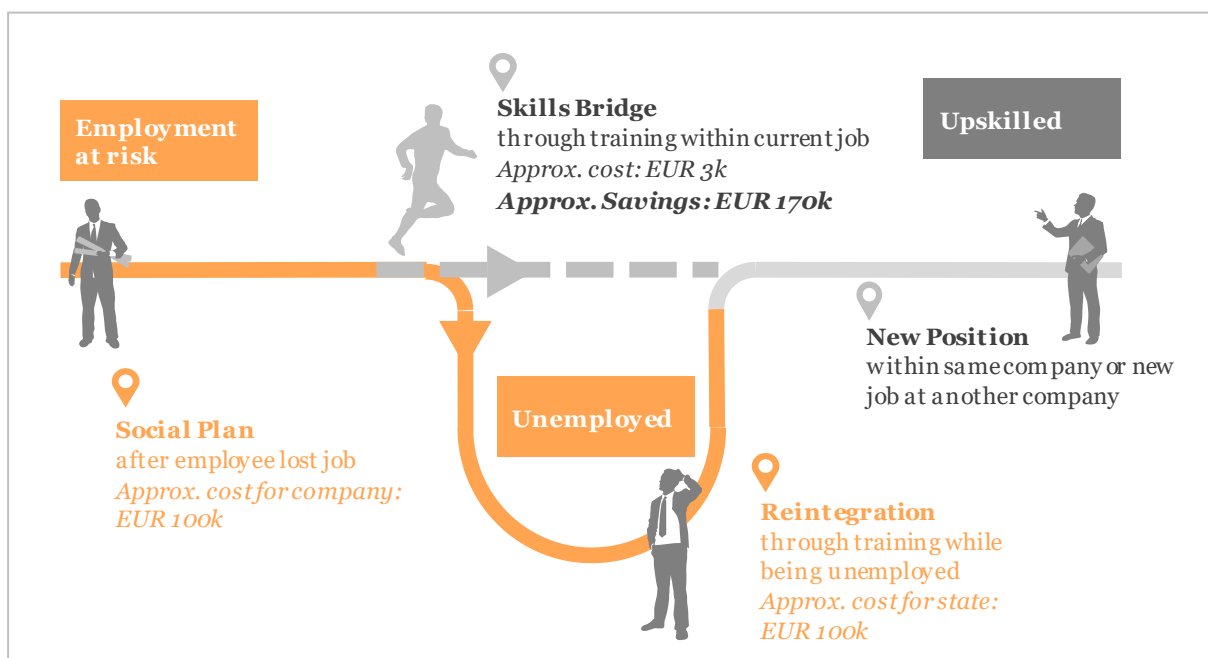




Figure 30: Bridging the skills gap

Whilst creating an incentive for companies to reskill their employees, Skills Bridge attempts to avoid the high social, societal and economic costs of unprepared workers for the economy 4.0. According to previsions, upskilling of workers will costs approx. EURO 30k, resulting in increased productivity, through which firms can save up to EURO 170k. The costs are covered by government through the Labour Fund (*Fonds pour l'emploi*) to which every employee contributes through their income tax. This contribution is justified by the supposition that the measure will avoid the consequences related to (structural and/or long-term) unemployment such as social and financial costs related to social plans and unemployment.

Up to now, 24 companies have applied and 15 companies are participating including more than 500 employees. Skills Bridge is being tested in businesses originating from all industrial sectors and so far the direct involvement of employees ranges between 4 to 70 per company.

Lessons learned

- Up to now, Skills Bridge is a single phase programme. However, in the next implementation period, it would be beneficial to divide the programme in a pre-project assessment encompassing a digitalisation and in a work force planning assessment. This will ensure that the programme accounts effectively for differences in the maturity of participants. While, large corporations tend to be well aware of the importance of digitalisation and have adopted measures that are in line with best practices, a great number of SMEs still faces significant challenges in the formulation of an effective digitalisation strategy. Compared to large businesses, SMEs tend to be more short-sighted in their planning as they need quick returns on investment. This often results in SMEs linking poorly the digital strategy of the company to work force planning. Visualising work force flows helps companies' decision makers to understand the need for digitalisation and the issues at stake

	<ul style="list-style-type: none"> • Whereas a consensus on digital skills and training seems relevant for all participants, most companies underestimate the necessity of non-technical and soft skills training • A dedicated legal framework should be designed. In the case of Skills Bridge an existing legal framework is used, which was put in place after the crisis of 2008 for partial unemployment (<i>chômage partiel</i>). In the context of digitisation unemployment has a negative connotation, which keeps employees holding back • No matter the size or the nature of the firm, continuous support is required at an individual level throughout the process to ensure successful implementation
<p>Prerequisites for the implementation of policy measures like Skill Bridge</p> 	<ul style="list-style-type: none"> • Representatives from the government, trade unions and employers organisation are aware about the issues at stake and are supporting the initiative through a tripartite agreement • The national or regional government understands the implications of rapid technological change, nurtures regularly relations with relevant stakeholders from the private sector and has the financial means to intervene • Adherence to the European Commission's New Skills Agenda for Europe and the Digital Skills and Jobs Coalition • Companies need to be aware about the risks and opportunities of the economy 4.0 and be responsive; support is provided on a voluntary basis • Sufficient availability of personal advisors for employee assessment and advice in the employee's upskilling journey. These personal advisors have to be trained and certified before their involvement

3.2.2 CAP'TRONIC (France) – Digital enabler

CAP'TRONIC is a French programme supporting French start-ups and SMEs from all sectors. It is not a new initiative as it was established in 1991, but in recent years, it has redirected its activities to the digitalisation needs of SMEs. Thus, it provides advisory services on the integration of innovative electronics and software solutions, which are intended to improve companies' competitiveness. The programme is managed by the JESSICA FRANCE association. CAP'TRONIC covers the entire French territory and has offices in Grenoble (HQ and south-eastern regions), Paris/Saclay (north-eastern regions), Nantes (western regions) and Begles (south-western regions).

The programme is geared towards French-law SMEs with a SA, SARL, EURL, SAS company status or associative type structure. CAP'TRONIC is funded by the Ministry of Economy and Finance. In 2016, the budget amounted for approximately 5M EUR.

In the pursuit of its objective, CAP'TRONIC (results for 2016) through:

1. Technical one-day seminars (2375 SMEs): raise SMEs' awareness on scientific, technical, techno-economic or regulatory topics related to electronics or embedded software
2. 2-3 days expert trainings and workshops (35 trainings and 30 workshops encompassing 347 SMEs): reinforce the control of on-board software


technologies of engineers and technicians within SMEs as well as provide support to SMEs on dealing with electronic issues

3. Technical and financial advice to SMEs in the implementation of their electronic solutions (707 SMEs): provide SMEs with first-level support in the definition of their project, the choice of the most appropriate electronic solutions as well as the best methods of implementation and
4. Expert technical support to projects (349 SMEs) as well as project monitoring (429 SMEs): led by expert from public or private competence centre it helps SMEs to define and launch its project (technical expertise) and/or accompanying its good execution (project monitoring).

Most services are provided free of charge, others require a membership of JESSICA FRANCE.

The measure is innovative as it associates advice and support of engineers specialised in electronics, essential for SMEs without electronic competence, as well as the intervention of experts from public or private centres of competence (universities, engineering schools, technical colleges, research laboratories, private experts, etc.) selected according to their ability to respond to the issues encountered by SMEs.

Since the project is government funded, it is subject to regular monitoring and evaluation. Between November 2009 and March 2010, an independent consulting firm mandated by the French government, has run an evaluation of the programme. Support of participating companies and report eased access to digitalisation products and services. CAP'TRONIC has a proven high leverage effect on company's turnover. The satisfaction of participating SMEs is in fact assessed as every expertise contract is accompanied by an evaluation sheet. The intervention of an engineer and/or expert is evaluated as "good" or "very good" (respectively 98.5 % and 97.8 % satisfaction).

<p>Lessons learned</p> 	<ul style="list-style-type: none"> • This initiative is governed by a single dedicated body, JESSICA FRANCE, which has more than a decade of experience in providing advisory services specifically to SMEs • CAP'TRONIC is also a long-time programme as it has been able to renew itself regularly. This does not only reflect its accomplishments in general, but also contributes to the quality of its knowhow when providing experience-based advisory services and expertise • A mix of private and public support (for instance through knowledge or funding), mostly free of charge, also positively influences the outcomes and impact of the measure • An important factor of success, especially as it is geared towards SMEs, is its regional presence. Whereas Paris remains an important region for the programme, regional isolated areas benefit from CAP'TRONIC as well • The initiative can be considered as inclusive, as most services are also provided free of charge (or require a membership of JESSICA FRANCE; the fee being proportional to the number of employees occupied by the firm). The advisory services are provided by experts, which can support SMEs with their specific knowledge
<p>Prerequisites for the implementation</p>	<ul style="list-style-type: none"> • Need to adapt the measure to national and regional socio-economic realities as well as build on the specific assets of the state and/or region

of measures like CAP'TRONIC



policy like

- Attract expertise and create platforms for sharing experience and (technical) knowhow
- Build on the long-time experience of existing entities (especially those who have been working either in the field of digital advisory services or SMEs)
- Sufficient funding through a diversified funding portfolio

3.2.3 Voucher per la digitalizzazione delle PMI / Voucher for digitisation in SMEs (Italy) – Voucher system

In the context of its national programme Italian Network Industria 4.0, the Italian government, through the Ministry of Economic Development (*Ministero dello sviluppo economico*), has initiated a voucher system named *Voucher per la digitalizzazione delle PMI* (Voucher for digitisation in SMEs). The vouchers are geared towards micro enterprises and SMEs in the pursuit of the digitalisation of their processes and modernisation of their technologies. Over the period of 2017-2019 a budget of 105M EUR is foreseen for the establishment of Digital Contact Points (Decree 219/2016) with 45M EUR (approx. 40 %) planned for vouchers.

The planned result of the measure is to encourage investments in ICT innovation and digitalisation among micro enterprises and SMEs. Thus, it should (1) facilitate SMEs access to innovation and knowledge; (2) enhance collaboration with public and research institutes; and (3) increase the availability of R&D infrastructure.



The vouchers can be used for the purchase of hardware, software and specialist consulting services strictly aimed at the digitalisation of business processes. Another use can be the purchase of hardware, software and specialist consulting services strictly aimed at modernising work organisation, with particular reference to the use of technological tools and the introduction of forms of work flexibility, including teleworking. Also the purchase of hardware, software and specialist consulting services for the management of online transactions and network connection security systems, and specialist consultancy services strictly aimed at the development of e-commerce solutions. The voucher also supports expenses for the construction of infrastructural and technical works, such as supply, installation, certification, testing of cables, and the cost of equipment and installation of the equipment necessary for broadband and ultra-broadband connectivity. Another support can be the expenses related to the purchase and activation of decoders and dishes for connection to the Internet via satellite technology. Finally, the voucher also supports costs for participation in courses and for the acquisition of qualified training services

In a first phase, the funding will affect eight regions in southern Italy; later it will be extended to the entire Italian territory. Each company can benefit from a single voucher of no more than EURO 10,000, up to a maximum of 50 % of the total eligible expenses. Purchases must be made after the reservation of the voucher. Between 30 January 2018 (access already granted on 15 January 2018) and 9 February 2018, applications had to of been completed and submitted per IT procedure on the Ministry's website. Following the realisation of the project, within 90 days of the expiry of the 6-month deadline for the completion of the subsidised project, the beneficiary company must transmit, again exclusively through the IT procedure, the request for disbursement. The beneficiary company is required to keep all the supporting documents related to the expenditure reported in general in the 10 years following the completion of the project. The beneficiary company allows and encourages, at every stage of the procedure, checks and inspections carried out by

the Ministry. The beneficiary company is required to ensure that a separate accounting system or accounting code is maintained for all operations relating to the operation, without prejudice to national accounting rules.

During the first round, 92,000 applications were received through the Ministry's e-portal, of which a maximum of 10,000 can be honoured. For addressing more applications, the current budget of 100M EUR has to be enlarged and the use of additional budget lines is considered.

DG Grow has evaluated the measure and recommends it as a measure of good practice. Despite limited resources, it in fact enables SMEs to access necessary digitisation products and services. Yet, it is too early to judge the success of the measure as it has only recently been implemented.

<p>Lessons learned</p> 	<ul style="list-style-type: none"> • In a first phase, it targets economically less favoured regions in the South, if successful it might be replicated in other regions • The programme has confirmed the need to support SMEs with vouchers, even if the limited amount of money is available per voucher • The application portal has to be user friendly in order to enable to applicants to concentrate on communicating their digitisation plans
<p>Prerequisites for the implementation of policy measures like Voucher per la digitalizzazione delle PMI</p> 	<ul style="list-style-type: none"> • For means of replication, regional stakeholders' need to conduct an ex-ante analysis and assess local specificities in order to have an overall picture of the economic performance, opportunities and weaknesses as well as actual and missing resources e.g. financial, skills, infrastructure, actors

3.2.4 Made different | Digital Wallonia (Wallonia, Belgium) – Digital enabler

The economy of Wallonia is not more than a quarter of the whole economy of Belgium and is growing slower than the economy in the Flanders region. There is a strong need for innovation and digitisation of the Walloon economy. Made Different is an awareness raising initiative for the digital transformation of companies in the Walloon region. Made Different carries out company diagnostics. It is part of the Digital Wallonia programme. In coordination with Digital Agency AdN (*Agence du Numérique*), Made Different raises awareness and provides support to firms in their transformation to industry 4.0 (or smart manufacturing). Before being a regional initiative, it has been a national one. A related initiative also exists in Flanders. Yet, they are sharing same methods and interacting, they are using their own resources and running their own projects. Made Different benefits from regional and European funding options. In 2018 the total budget of was 2.4M EUR.

The activities undertaken by the initiative encompass (1) awareness raising through informal meetings and demonstrations; (2) diagnosis; (3) support; (4) internationalisation; as well as (5) networking and exchange of good practice

between experts from competitiveness hubs, sectoral federations, research centres and clusters. Made Different also regularly organises events and produces articles on its undertakings. An important annual event for Made Different is its *Factories of the Future Award* and the nomination of winners as well as ambassadors. The aim is to create success stories, which should have an inspiring function.

The program follows a transformation plan composed of two phases: (1) awareness raising and (2) support. This involves different tasks and activities following the logic presented in the figure below.

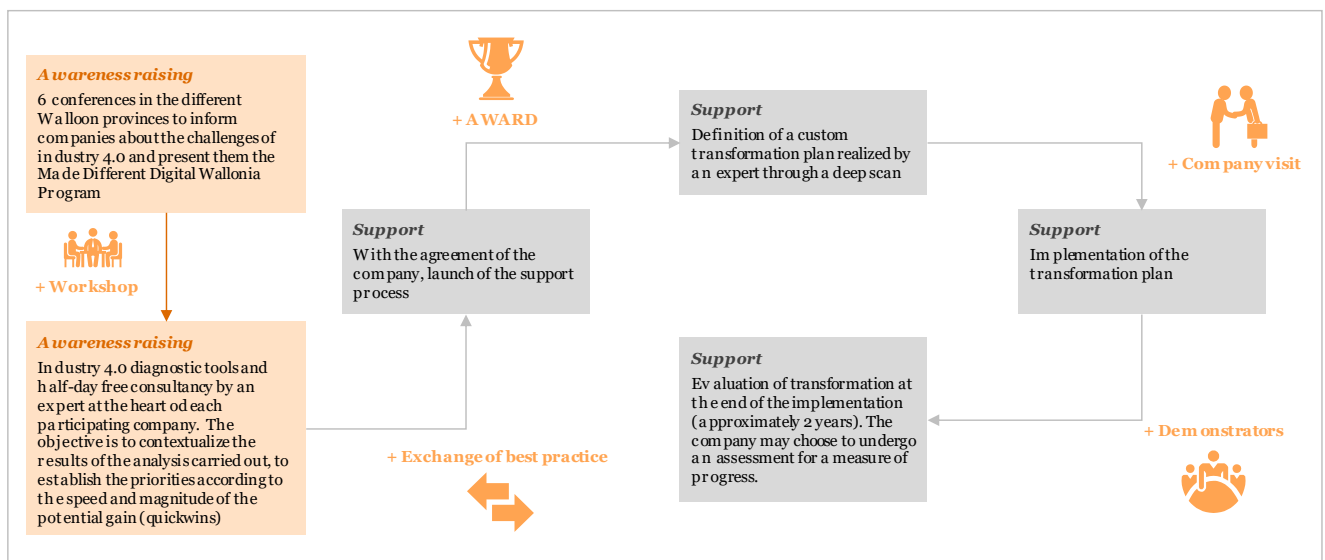


Figure 31: Phases, including tasks and activities

Awareness raising action covers (1) smart processes; (2) smart products; (3) smart business models; (4) professions of the future and humans at the heart of the company; and (5) business networks.

Made Different further supports transformation, also called "7+1 Transformations," in other words:

1. World Class Manufacturing Technologies: implementing the most recent production techniques
2. End-to-End Engineering: developing products and services according to the value chain considered in its entirety i.e. taking into account production, sales, technical maintenance and recycling
3. Digital Factory: preparing the ground for the merging of the real world and the digital world i.e. digitisation as well as digitalisation and its implications
4. Human Centred Production: involving employees in the future development of their company
5. Networked Factory: ensuring a flexible cooperation of suppliers and partnerships in an optimal ecosystem
6. Eco-Production: certifying a sustainable production system takes into account all phases of a product's life cycle, including the supply of materials, production, use of the product and ultimately end-of-life management



7. Smart Factory: responding to changing market demand, with the ultimate goal being the ability to batch produce a single unit on demand
8. Smart Business Model: transforming and innovating business model (including research of new opportunities with high added value). This part of the programme includes advice on strategy, purchasing and sales, and businesses supported through the Interreg MecaTech project.



Figure 32: Main and additional services

Regarding the measured results, around 350 companies have gained greater awareness through activities organised by the partners; more than 120 companies have been approached to carry out a thorough analysis of their situation; more than 60 companies have carried out a digital maturity diagnosis or an in-depth scan to identify the gap between their situation and their objectives.

Lessons learned	<ul style="list-style-type: none"> • The need for awareness raising has been firmly confirmed during the implementation • The more an event is considered “prestigious” the more participants will attend it • The cooperation with local stakeholders as well as the organisation of sensitisation events are important. One third of the participating SMEs are already actively seeking information. The challenge is to involve companies less aware of the issue or tend to be reluctant
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	<ul style="list-style-type: none"> • Made Different's most successful part is the nomination for the Factories of the Future Award and its digital maturity diagnostics diagnosis • The role of the Factories of the Future and Ambassadors is valuable as they can serve as models for the industrial sector to share industry's experiences with their peers • Internationalisation of the targeted companies is hardly having an effect through Made Different and most probably needs other measures
<p>Prerequisites for the implementation of policy measures like Made different</p> 	<ul style="list-style-type: none"> • A Digitisation strategy should be in place, which is carried out by an agency fully dedicated to this strategy • Need for a targeted communication campaign for awareness raising • Made Different is a complex programme covering many different areas and activities. Therefore it is advisable to limit the scope of a future programme to awareness raising and diagnostics

3.2.5 Digitisation and Innovation vouchers (Digitalisierungsgutscheine und Innovationsgutscheine) (NRW, Germany) – Voucher system

Within its Mittelstand.innovativ! programme, the Ministry of Innovation, Science and Research (Ministerium für Innovation, Wissenschaft und Forschung) of North Rhine-Westphalia (NRW) has set up a voucher system, specifically dedicated to the innovative companies. The voucher system is set up to facilitate, increase, and further drive cooperation between SMEs and higher education institutions (i.e. universities, research institutions and entrepreneurial competences). The voucher programme is implemented by Projektträger Jülich.

Two types of vouchers exist:

1. Digitisation vouchers, are intended to plan, develop and implement new products, production processes or services, taking into account digitisation options. It also aims at strengthening the innovative ability and growth orientation of the craft industry in NRW. The goal is to strengthen the innovative capability and growth orientation of companies around the topics of digitisation and IT security in NRW.
2. Innovation vouchers are designed to support R&D of new products and services at all stages of the value chain. Substantial qualitative improvements of existing products and services can also be promoted. They can also be used for projects with work and organisational issues.

The budget for 2017 amounts is 4.3M EUR.

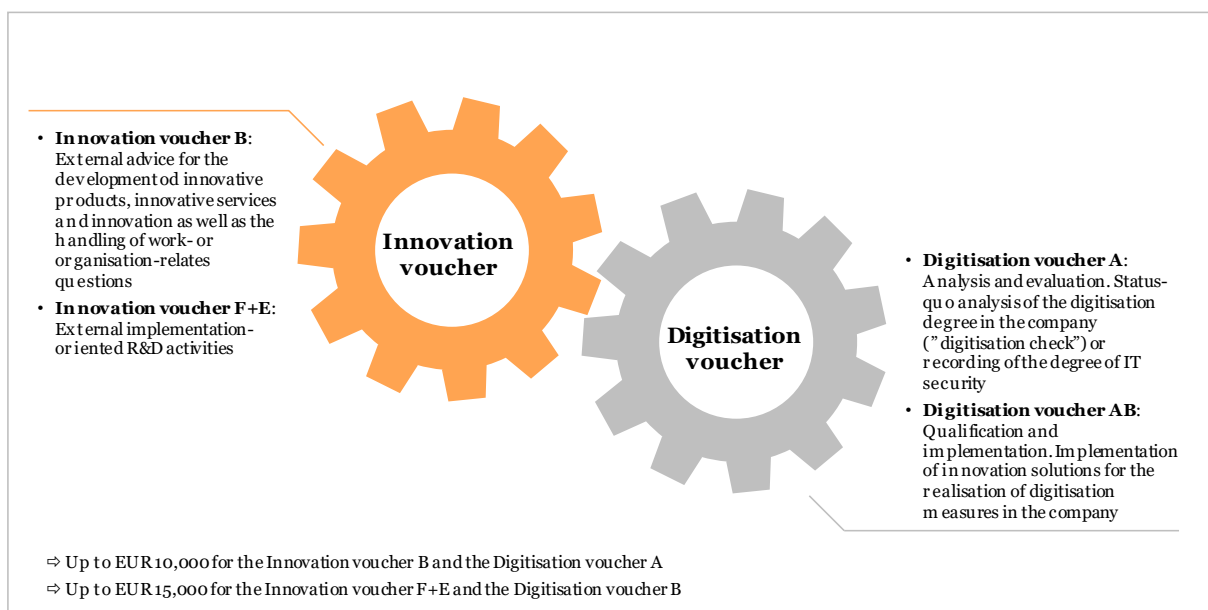



Figure 33: Innovation and Digitisation vouchers

The programme is geared towards SMEs with less than 250 employees and max. 50M EUR annual sales or 43M EUR annual balance sheet that want to generate innovation related to digitisation and IT security. Pure investment projects, the purchase of hardware and software licenses are not eligible. Support measures are limited in time to the implementation period. The company seat must be in NRW. Within a period of two years, a company may use a maximum of two support modules, provided that they build on each other (Innovation vouchers B and F+E or Digitisation vouchers A and B).

Candidates benefit from a permanent possibility to submit applications. The vouchers must be used in such a way that the project can be completed within a period of up to one year from the date of the notification of the grant. After completion of the measure, the innovation vouchers will be redeemed within six months by the project sponsor Jülich by requesting the funding. Thus, the beneficiary company has to fund in advance and will then be reimbursed. A copy of the invoice, including detailed prove of payment and implementation, have to be submitted. The reimbursement will then be carried out by Projektträger Jülich.

<p>Lessons learned</p> 	<ul style="list-style-type: none"> • The success and accordingly demand for vouchers, both innovation and digitalisation, is growing • User-friendly and easy application modus is a key success factor • Goal-oriented nature of the implementation and its straightforwardness is a sine qua non for appreciation by the participating companies • There is a real potential for further impact by formal involvement of Digital Innovation Hubs and other similar actions in Germany or in the EU. Exchanges with Digital Innovation Hubs and research entities take place, but there are no incentives to develop them further
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Prerequisites for the implementation of policy measures like Digitisation and Innovation vouchers



- An on-line user-friendly interface eases the application process
- Sufficient funding to implement the measure is key for success
- The preparation of a voucher programme should map the needs of SMEs, which has to be monitored continually during implementation of the measure
- In order to be able to cover all specific technical needs, cooperation with a rich palette of research institutes is necessary

3.2.6 Competence, Innovation and Flexicurity (Comiflex) (West Sweden, Sweden) – Skilling measures

The West Swedish reskilling measure Comiflex (Competence, Innovation and Flexicurity) was set up in response to the 2008 crisis, which amongst others hit the automobile sector. The measure was based on an inclusive approach, involving not only business, but also politicians, civil servants, and academics. Comiflex was managed by the communal federation Sjuhärads kommunalförbund, which has as an objective to create exchange and promote cooperation and innovation. It specifically concentrates on growth and regional development issues, infrastructure and transport, culture, education, skills development as well as social welfare and health. The kommunalförbund is a cooperative federation of nine municipalities. Comiflex started in the autumn of 2009 and ended in August 2011.

The Comiflex initiative needs to be placed in a vaster national context in which regional authorities and related regional bodies were given the task to establish Regional Skills Platforms (Regionala Kompetensplattformar). The platforms are designed to improve cooperation over the provision of competence and education planning in both the short and long term – the idea being to improve coordination between growth policy, labour market policy and education policy. The project, with a total budget of 18.3M SEK (approx. 2M EUR) was fully funded by the European Social Fund (ESF).

The measure has identified and selected actors for the organisation of training sessions. Thus, e-skills trainings have been offered to about 2,000 workers from 29 companies, mainly from the car and components industry in Sjuhärad and Halland. This region had suffered from the closing of plants from the car industry. Given its success, the measure was extended for another 3 years, involving 54 companies, this time specifically focusing on female workers (682 of the trainees were women). One of the goals of Comiflex is that at least 75 % of the project participants at the end of the project must have created a training plan and / or an education policy to promote lifelong learning at the workplace.

All training providers were informed that after the end of the project there would be an award given to the best provider. When approximately 10 training providers had been nominated in the final phase of the project, a vote was made. The winner was awarded the "Comiflex Excellent Teaching Award", or C.E.T.A. Companies were also informed of this award early, which meant they were more active in evaluating and

assessing courses and course leaders. Such a prize has proved to be a real spur for the education providers to do their utmost to at least be nominated. The prize thus became a tool for continuous quality assurance of the courses. The winners were presented and they received a glass sculpture, in conjunction with Comiflex's final dissemination conference. Media also showed interest for this prize and its winners.

According to its evaluators Comiflex broadly achieved its goals to increase individual employability, to promote life-long learning and to strengthen cooperation between the municipalities in the Sjuhärad region regarding the business community training needs. In close cooperation with the Swedish Trade Council and the Europe Enterprise Network training courses were provided to find new areas in innovative development and to access new markets. A special study was performed after the needs and opportunities for collaboration and cluster development for SMEs in manufacturing.

Many companies have testified being able to make savings through Comiflex. The initiative observed that many companies have no structure for knowledge transfer and lack a process for training needs. An unexpected and positive effect of the Comiflex initiative are new collaborations between companies that have not previously collaborated. They found new ways to work strategically on skills development and increased knowledge of the supply of education providers who maintain high quality. One of the most significant synergies that Comiflex has achieved is the new brand model Volvo Buses which has implemented the continuous competence development and flexibility of the personnel. The Comiflex project has resulted in the creation of a new Competence Council led by the Sjuhärads municipality. This Council's long-term goal is to improve collaboration between educators, in both the private and public sectors, as well as business and municipalities on further strategies to meet labour market needs.

<p>Lessons learned</p> 	<ul style="list-style-type: none"> • Working out good communication and a trustworthy relationship with project-participating companies as well as training providers is essential • Regular visits to the companies have to be planned for, to keep a good relationship • Project logs should be kept in which issues are recorded and updated, rather than creating project diaries in which actions are recorded • Companies are accounted for, if there are empty places in the training courses. This is a good motivator to complete all training opportunities • It is important to create procedures for how new acquired knowledge is utilised, after employees have participated in skills-enhancing efforts • Involving an external procurement expert is essential for the proper procurement of external training courses • Good quality of the education providers is essential
<p>Prerequisites for the implementation of measures like Comiflex</p> 	<ul style="list-style-type: none"> • Regional authorities should be mandated by the national government in improving skills at a regional level • Early on well prepared strategy planning to apply to the European Social Fund • Cross sectoral cooperation between companies and between competing companies should be feasible; if such cooperation has not taken place before, intentions for cooperation should be formalised in letters of intent • Platforms for the exchange of information and experiences should be established • Gender discrimination should be identified and be able to be targeted, as the exclusion of female leaders and the underinvestment in female workers undermines the potential to contribute to innovation

4 Challenges and lessons learned from the project

The Smart Factories project is focused on the new EU Member States, where the DIH concept is still relatively new and not widely spread among companies and policy makers. The below chapter presents our findings relating to barriers in developing DIHs, their needs as well as general awareness relating to DIHs among public and private entities.

The project team has also worked closely with over 30 DIHs in the region which helped us identify and understand challenges faced by those organisations in becoming and flourishing as fully operational one-stop-shops for SMEs and industry to help them benefit from introducing new digital technologies to their businesses. This has also allowed us to draw observations on DIHs' expectations of the European Commission and national authorities as well as assess their universal needs. The following sections will discuss this in more details.

We have also witnessed significant increase in the awareness of stakeholders during the course of the project, which is very encouraging. Raising interest in DIHs from policy makers and public authorities might suggest it will become an important element of digitalisation-related national and regional policies and will be translated into tangible activities in those Member States.

It is fundamental to appreciate that the group of 34 DIHs participating in the project was very diverse. It included hubs at very early stage of development, which actually were just taking their very first steps as DIHs, but also those, which participated in the previous training and mentoring project implemented under I4MS initiative and were fully operational considering the DIH Catalogue approach. Challenges faced by each group are different and might require different solutions. Level of investments required for infrastructure, skill set/human capital, governance is one of differentiating factors. Another one is access to different potential funding sources considering DIHs needs, but also service and financial track-record.

The project worked also with DIHs which operate as regional hubs offering relatively universal services to clients from their region. It can be attributed to their local connections and long-lasting cooperation of DIH members and their partners often preceding the setting up a given DIH. While other DIHs were clearly building their offering reaching beyond their local markets, but focusing on a specific sector (manufacturing), topic (cybersecurity) or technology (HPC). Their approach to market, offering validation, client base or marketing strategies have to consider different geographical coverage of those hubs.

Another important aspect when considering barriers faced by DIHs is their legal and organisational background. The project included DIHs set up by governmental entities and regional authorities, associations and non-for-profit organisations as well as private entities. Their operational models, partnerships and funding mechanisms were often completely different.

Such a diverse group of DIHs required individual approach to training materials and mentoring activities. This reflects the fact how flexible the concept of DIHs is and how many implementation options there are.

The below section discusses key challenges we have identified hindering development of DIHs and a DIH network in the region. The severity of problems differs from one Member State to another, but we selected and analysed issues raised horizontally by DIHs participating in the project. Our findings show that access to finance, which is often flagged, might not be the most crucial challenge faced by DIHs in developing themselves and supporting businesses in the digital transformation. Our assessment of the situation indicates that the lack of awareness of digitalisation benefits is universal and key in hindering the development of DIHs.

4.1 Awareness of digitalisation benefits among SMEs

Insufficient knowledge about new technologies, their possible application in SMEs daily operations or products as well as inability to translate them in tangible, quantifiable and imminent way are the critical factors influencing development of DIHs. The challenge in a variety of aspects was raised by almost all our interviewees and was present during our discussions with DIHs themselves. The below section aims at presenting modalities of the topic, its implications on DIHs and possible remedy actions.

Even though terms such as Industry 4.0, digitalisation, Internet of Things and Big Data are universally used nowadays, they often are used as buzzwords without adequate knowledge of what is really behind them. It is safe to state that some terms relating to new and emerging technologies lack clear definitions and are often used with a different meaning in public discussions. This is understandable as the surrounding ecosystem has been evolving, if not revolving, and a certain rate of flexibility is needed to follow ongoing disruptions.

Nevertheless, this phenomenon does not help to gain full understanding of what new technologies are for bystanders. It can be anyone ranging from an entry-level employee of an international corporation, an executive of SMEs or C-level staff of a large companies, or even specialists in any given field of expertise. The level and the rate of disruption is unprecedented. Thus, people are often lost when it comes to comprehending the change, not to mention to visualise actual benefits. Companies may not be able to imagine the benefit coming out of these implementations. They cannot see what concrete improvement it would bring or they might have not received an offer that would push them further on the market. If employees and managers of companies are not able to understand digital transformation, it is extremely difficult for them to foresee potential gains of the process.

It proves the need that almost anyone from owners and top management to the staff is educated on new technologies and their benefits. SMEs in the Central and Eastern Europe often do not know of technologies and solutions, which can be applied either horizontally in their industry or specifically in their company. They also do not have access to a trusted source of information that would provide practical advice. Lack of knowledge, time and lack of hands-on support on how to uptake digital solutions makes it extremely difficult to change and incorporate such tools into internal process and products.

SMEs have limited awareness about the benefits that they can acquire after adoption of digital solutions. SMEs do not know what is possible and are afraid of the cost they have to pay for digitising. They are not aware of the potential cost optimisations and capacities expenditures that can result from digital solutions. SMEs also do not understand the necessity of these crucial steps towards digitisation unless they have

a specific problem. The underlining conclusion is that businesses, which do not appreciate potential benefits of going digital, will not seek support in transformation.

Potential customers of DIHs – SMEs and the industry – can understand the benefits of digitalisation only after having experienced them or at least having becoming aware of potentially applicable use cases. As evidenced by some DIHs participating in the project, open information sessions on new technologies result in growing number of SME customers seeking paid services of DIHs.

Recommendations:

1. Promote benefits of digitalisation in a non-technical manner using an open European platform to:

- **Present use cases and success stories of business solutions based on new technologies**
- **Develop a catalogue of SME's processes and tasks, which can be enhanced with the use of new technologies. It should also offer exemplary methodology on e.g. cost saving, internationalisation, new intellectual property;**

There are a number of initiatives supported by the EU, which have already resulted in a great number of success stories and use cases. Best known initiatives are possibly I4MS and SAE. However, there are other projects financed from Horizon2020 and ESIF budgets which can offer insights into digitalisation benefits. Proper management of such knowledge is necessary to fully capitalise on the investment made by the EU.

It is recommended there is a platform serving a one-stop-shop offering a comprehensive repository of use cases and success stories regardless of the source of funding. One shall not expect that SMEs lacking awareness of digitalisation benefits would be able to navigate between different EU initiatives. The platform shall present cases grouped and categorised in such a way that a person with no EU-funding background should be able to locate interesting cases.

Success stories should be described in a relatively non-technical manner while focusing on benefits to the company implementing the new solution. As discussed above, investment decisions of SMEs are often taken by non-technical management boards. Thus, the success stories should be appealing to business gains rather than focus on detailed technological solutions. Technical support is to be obtained from a DIH or supplied differently. It would support marketing efforts of DIHs in attracting SMEs to enter into cooperation with the DIH as real use cases are very powerful tools for presenting benefits of new technologies to SMEs.

Additionally, the platform could offer a catalogue of processes and tasks often present in SMEs and in the industry which can be enhanced with the use of new technologies. It would need to be preceded with a mapping exercise and complemented by the evaluation of benefits to a company from digitalising each tasks or process or product. This would only serve as indicative estimations, but would certainly draw attention of the public.

2. Each DIH receiving any public financing should be required to carry out complementary public awareness and educational activities.

Some of DIHs participating in the project act towards raising awareness on benefits of digitalisation. The extent of activities and modus operandi differ greatly; some of them see those activities as business development while others are involved because

of statutory obligations. Due to a very special and complex role of DIHs it would be recommended that all of them contribute to educating the public. This is particularly important to those DIHs, which receive public financing of any kind. Such an obligation would be included into each contract and the level of effort calculated based on funding allocated.

4.2 Access to funding

This is probably the most often repeated barrier when discussing DIHs. However, our analysis suggests that evolutionary steps and adjustments are necessary rather than an introduction of major game-changers. There is a need to address specific gaps hindering development of DIHs with well-targeted funding rather than to structure a fully-fledged financing mechanism.

In order to get access to funding at the regional and national level, it is fundamental for DIHs to develop a sustainable business model. Creating that sustainable business model should start with defining an attractive and affordable set of services that can be delivered by the Digital Innovation Hubs to the market. In order to do that, the basic infrastructure of the hub should be financed by national funds or regional development funds. Then, it is crucial to attract potential clients, e.g. tech SMEs, manufacturing industry SMEs, SMEs in the service sector and even entities from the public sector. After defining the potential clients, the next step is to define what actually do they need from hi-tech solution providers and, if the clients have a need to get a public funding – so not directly tapping into funding of DIHs, but maybe helping clients to identify potential sources of funding. Finally, it is important to perceive DIHs as a consulting platform, not only as and R&D technology provider. Furthermore, it is crucial to remember that DIHs have a societal function; therefore, public money is needed to finance those functions that are non-revenue generated. Because of that societal function, the national and regional public initiatives should be linked with DIHs.

The DEI initiative, which introduced the concept of DIHs, was published in 2016. At this time operational programmes offering ERDF and ESF funding had already been drafted and agreed with the European Commission. Therefore, none of those programmes offered dedicated financing to DIHs nor categorised DIHs as eligible beneficiaries. Changing the status quo – enabling operational programmes to support DIH – would require amending the whole programme document, which can be a very lengthy process requiring a governmental decision and proceeded by negotiations with the European Commission. DIHs did not emerge as priority topic to managing authorities of 2014-2020 operational programmes as none of the EU13 managing authorities introduced DIH-exclusive amendments to the programme document.

On the other hand, we found that DIHs are often part of larger organisations such as universities or competence centres, which use ESIF and other EU funding opportunities for their development. Significant group of our DIHs is coordinated or incorporates technology parks and universities that were funded by 2004-2006 and 2007-2014 national and regional operational programmes. Therefore such DIHs do not need to do initial investments in own buildings or equipment as it had been already funded. Similarly, even DIHs not being part of such large organisations, in line with the concept of DIHs, can and should team up with entities already offering access to labs, testing beds, and other relevant infrastructure. ESIF funds support DIHs and involved organisations also in non-infrastructure components relating to SME competitiveness and digital services.

Recommendations:

1. Ensure that Digital Innovation Hubs are recognised by 2021-2027 national and regional operational programmes as eligible beneficiaries.

There seems to be limited added value in amending ongoing 2014-2020 operational programmes to support DIHs as they are in the final stage of implementation. The formal process is lengthy and a number of projects to be supported is rather insignificant due to limited funds which would be unallocated by then. It seems to be much more relevant to ensure that the national and regional operational programmes of the 2021-2027 financial perspective include DIH-related activities as eligible measures.

A mixture of top-down and bottom-up approaches can facilitate this. The first one requires aligning the positions of DG Connect and DG Region on DIH-supported measures. DG Regio offers guidance and support to national managing authorities in developing operational programmes. Having a clear message from the DG Regio that DIHs are one of key focus areas for the national and regional programmes dealing with digital challenges could result in the EU-wide recognition of DIHs as eligible beneficiaries of ERDF and ESF funding. The bottom-up approach means approaching national and regional stakeholders and raising their DIH-awareness, which would then translate into a critical mass pushing for greater recognition of DIHs within operational programmes. Both approaches were observed during the implementation of the Smart Factories project and further intensification of efforts is necessary in coming months, when the new financial perspective will be shaped.

DIHs should stay local when possible and go European when necessary. The value of DIH cooperation is mostly seen in the support of community building, the de-risking of new cross-border industrial value chains and in the compensation of missing competences in the own network. There are dedicated initiatives which offer support in building a network of DIHs, but due to their limited scale they impact only a portion of DIHs for a limited period of time. Also, DIHs can spur innovation across regions, but at present there is an acute lack of funding for innovation that spans multiple regions that are not geographically connected (transnational). In the absence of dedicated instruments, DIHs are left to coordinate their own regional schemes as good as they can.

Therefore, special attention should be paid to cross-border cooperation programmes such as Interreg programmes. Even though their allocated budget are relatively small compared to national or even regional programmes, there are several factors why those programmes should be taken into consideration when developing DIH-support measures. Interreg programmes aim to support cross-border and interregional cooperation between different entities in at least two Member States which can be used to support collaboration of DIHs and the development of the whole DIH network in the EU. Secondly, those programmes are seen as frontrunners of mainstream operational programmes. They are used to pilot and test innovative approaches to EU-funded support, but also often focus on innovation and digital components. Since Interreg programmes cover at least 2 regions, they also need to draw on synergies of relevant Smart Specialisation Strategies for the whole programme area. It might also be important that DG Regio plays a very active role in developing Interreg programmes, because the process needs to be coordinated with at least two Member States and several regional authorities. Assuming that DG Regio is ready to facilitate the introduction of DIH-support elements to operational programmes, it would be easier to do so in such programmes.

2. ESIF funding opportunities should focus on short- to medium-term support in a form of capacity building measures and technical assistance projects.

DIHs are very rarely created as green-field investments. In most cases DIHs originate from the existing business innovation support entity or research organisation and they have access to necessary infrastructure. However, DIHs bring revolutionary changes in the way such organisations shall operate. Partnership, sustainability and the need to act as one-stop-shop require deeply rooted organisational changes. Strong expert support or access to knowledge offering guidance on the new operational model is crucial for DIHs success. DIHs initial phase, when a governance model, financial plans and a portfolio of offerings are defined, is a learning curve for the whole organisation and partners. Technical assistance projects and other forms of capacity-building support measures could allow DIHs to gain knowledge and experience necessary to operate more efficiently as a DIH. This includes access to best practices, networking and experience exchange opportunities with other DIHs, but also support to coordination activities within the DIH.

This initial phase requires relatively small investment from the DIH's coordinating body, nonetheless it is considered high risk. First potential revenue streams are uncertain and forecasted most often between 3rd and 5th year of operations. We observed that even relatively small financial support to newly set up DIHs can give them impetus to further development. The initial "investment" can also leverage other public sources before a DIH can become fully operational.

The DIHs participating in the Smart Factories project flagged that they struggle with securing funds for the initial phase of setting up the DIH, when there are no revenue streams to balance operational costs. Therefore, some of the DIHs' coordinating organisations seemed to stop half-way the transition from their current role to a DIH to wait for governmental and EC's decisions on support measures before any further investments are decided. In order to support the transition into a fully operational DIH relatively small financial support could be offered. This is sometimes referred to as "bridge financing", which has slightly different meaning in commercial banking. However, for the lack of a more commonly used phrase, it seems to be a good choice. A future pan-European operational programme or national operational programmes are better suited to channel the support due to the economy of scale. The regional level of operational programmes does not seem to be suitable, because a number of beneficiaries in a given region would be very limited. Considering that a desired number of DIHs in one region is limited, costs of setting up appropriate mechanisms in a regional programme might not be proportional to potential benefits.

Several alternative types of support could distribute bridge financing to DIHs. Most attractive type for the beneficiaries are grants. However, this type of support has relatively smallest impact on the level of sustainability of a DIH. Many organisations, including some DIH's coordinating bodies especially in the new Member States, organise their operations around possible funding opportunities becoming highly-dependent on public funding. Therefore, offering grants requires setting up a proper selection, evaluation and monitoring mechanisms to ensure such support adds value. Otherwise, it might have adverse effect on long-term sustainability.

Two other types of support might have a longer-lasting impact on DIHs benefiting from such support. Those are vouchers and financial instruments. The first one would work on similar assumptions as vouchers offered to SMEs that wish to use services of DIHs or other eligible service providers. Each voucher would be connected with a

specific service delivered to DIH on need-basis. While financial instruments supporting DIHs would offer revolving financing in form of loans, guarantees and other risk-bearing mechanisms. One of the main advantages is that it would allow for recycling of funds over the long-term perspective. Another important factor is that the use of financial instruments would mobilise additional private funding to DIHs. Therefore, DIHs would need to be financially viable and have a clear path for becoming financially self-sustainable. Otherwise, no private funding would be granted.

3. Broader application of the partnership principal in ESIF programmes

We noticed that DIH coordinating bodies prefer to apply for funding not as DIH consortium, but as a single entity. This is motivated by the fact that a DIH as a consortium has no advantage over single entities. There is a very limited number of EU-funded programmes which promote partnership and where DIHs can have the upper hand. Those are for instance H2020 and Interreg programmes which require that interregional cooperation is an important part of the project. If DIHs are supposed to operate as connectors for the whole regional innovative ecosystem, they should be rewarded for developing joint project proposals/applications for funding. Instead, they are often penalised for complex governance structure of proposed actions, shorter existence on the market or weaker financial standings.

It is clear that the partnership principal does not provide benefit in all types of support measures covered by operational programmes. However, it should be introduced to the operational programme document and to specific guidelines for selected calls for proposals. Otherwise, operational programmes might not be able to address market failures connected with the lack of or insufficiencies in the coordination of regional innovation stakeholders and resources.

4.3 Policy support and cooperation with national and regional authorities

Public policy is essential to the success of the digital economy, which is showcased by examples of the Netherlands, Germany, Finland and Sweden. Those countries have highly innovative and high-performing digital sectors, while also having strong government and policy involvement in shaping the digital economies. Countries outside the EU which are global leaders in digitalisation (such as Singapore, New Zealand and the UAE) and those which are quickly catching up (e.g. China, Malaysia) all have implemented complex policy measures and where governments and regional authorities play an active role in addressing market failures.

The European Commission plays a very active role in setting up relevant policies and mobilising national and regional stakeholders. As a result, most of the EU15 Member States adopted national digital strategies. EU13 Member States, also work on or have already adopted similar strategies. However, DIHs are not recognised by national strategies in those countries. They are not seen as important players in the innovation ecosystem and their role is not taken into account when translating strategic documents at the operational level of policy making. National strategies are not the only policy documents not noting DIHs. Very often smart specialisation strategies of regions do not mention DIHs as crucial stakeholders. This is linked with DIHs recognition by national and regional authorities as important stakeholders. Awareness-raising activities among national and regional authorities responsible for ESIF programming shall be continued. This is also a fallout of the fact that most smart

specialisation strategies were drafted before the appearance of DIHs in those regions (at least in the EU13).

Recommendations:

1. Ensure recognition of DIHs in national and regional strategic documents.

The lack of clear recognition of DIHs by national and regional authorities limits DIHs role in a given region. Regional authorities have no policy framework to include DIHs in policy-making process and the implementation of digitalisation strategies. As a result, each region may adopt completely different cooperation models with its DIH/s depending on informal factors and the strength of relationships between a DIH and regional authorities. If there is no consistency across regions, coordination efforts between authorities and DIHs are also less effective at the national level.

When DIHs are included in strategic documents, their role can be aligned with other national and regional efforts while clear objectives are set for their activities. Thus, DIHs can better design their service portfolio and offerings to build on synergies with other stakeholders in the region and better support policy actions on the national and regional level. In return, DIHs can be seen as eligible beneficiaries of national public financing support and considered as an important stakeholder in policy discussions.

2. Setting up a national framework for digital transformation

The idea was developed during a workshop organised by Smart Factories project in Brussels to discuss possible DIH support measures. It suggests that if you have no national framework for digital transformation, you are going nowhere. Framework would be beneficial for both the society and industry. Essential for this idea is appointing a national coordination who will supervise all the actions necessary for developing this framework. Coordinator builds action plans and decides which member of the ecosystem will help with each action. This solution would foster cooperation, nurture open innovation process and promote an organisational culture that supports innovation. It would also help to understand the market needs and to carry out a benchmarking process in order to understand the market changes and SMEs' changing behaviours.

It could also be supplemented by a creation of national platform for DIH cooperation. It would not only be used to align activities with the national authorities, but also to enhance cooperation between DIHs themselves. Such a platform could be a forum for experience exchange, lesson learning and building networks. One of platform's objectives would be to develop policy recommendations on supporting the digitalisation of industry by offering insights collected from DIH's customers and suppliers.

4.4 Human Capital

There seems to be a need to align the level of investments in infrastructure and human capital of organisations coordinating DIH. Some of the DIHs that the Smart Factories project worked with have access to excellent infrastructure. This includes advanced laboratories, testing facilities and other equipment, which in most cases was financed by ERDF funding as part of another project implemented by a university, research institute or technology park. Those organisations employ a large number of highly skilled specialists focused in a given field of science who can utilise the infrastructure at hand.

At the same time, those organisations rarely invest appropriate funding to employing adequately skilled DIH coordinator's team. We noticed many cases when the coordination of DIH's activities was handed over not to a dedicated team, but as an additional task of staff already employed. Such an approach has high risk of not using the full potential of a DIH. There are a set of fundamental skills required to set up and run a DIH: ecosystem assessment, market analysis, business development, business modelling, business planning. These are just an example of the kind of knowledge DIHs have to build in order to be successful. This requires a broad mix of expertise other than core research and development competencies and is not always readily available. We believe that most DIHs in the EU13, especially those that are new or expanding, have a need for capacity building and skills development. Retraining of current employees on how to run a DIH or onboarding of new employees is a necessity.

Another important aspect relating to human capital is lack of staff able to offer guidance on application of new technologies in real life business processes and products as well as on integrating different technologies for the benefit of an SME. There are a variety of supporting industrial digitalisation technologies (e.g. 'Internet of Things', robotics, artificial intelligence), but fundamentally it is the integration of these cyber and physical technologies into production and logistics that benefits business the most. Integrated solutions allow companies to form, increase speed to market, integrate and strengthen supply chains, and allow productivity gains to be realised. The application of these known and emerging technologies will continue to disrupt companies.

Even DIHs, which should be offering advice and guidance on application and integration of new technologies, struggle to attract relevant experts. The challenge that some DIHs have already or will likely face is a brain drain of its qualified employees. We noticed cases when even companies acting as DIH members attract skilful employees of a DIH's coordinator. Therefore, a training process for DIHs' staff should be a consistent and regular activity – not just an element of the initial phase of the setting up a DIH.

It needs to be noted that shortages in qualified staff is as severe challenge to DIHs as to SMEs in the EU13 Member States. Companies from the Central and Eastern Europe often as seen as less attractive than large international companies with offices in the region or with opportunities outside the region. Another reason, which was voiced during our work with DIHs, was the lack of alignment between curriculum offered by universities in the region and the needs of companies.

Recommendations:

1. DIHs become eligible beneficiaries of ESF operation programmes of 2021-2027 financial perspective and national frameworks offering training funding.

As mentioned above, DIHs are in need of constant training to excel their services to SMEs and the industry. It is important to ensure that those organisations have access to the EU funded trainings. Such trainings have a potential to multiply its benefits, as DIHs would be passing the knowledge further multiplying its impact. National and regional ESF managing authorities should include DIHs in the list of eligible beneficiaries. If there are any other training opportunities funded from national budgets available in a given country, it would be important to ensure they also cover DIHs.

2. DIHs should actively participate in developing study and training programmes

Challenges relating to human capital faced by DIHs and SMEs partly result from a lack of connection between university study programmes and market needs. Many universities work on changing their strategies by introducing responsive research and innovation programs that can be coordinated with the industry and in that way respond better to its needs. This process can be further enhanced by cooperating closely with a DIH from the same region. Since DIHs are much closer to the market than universities, they have better understanding of educational challenges faced by SMEs.

Additionally DIHs could develop and deliver regional training programmes for SMEs. Those could be funded from regional or EU funds and offered to SMEs as complementary or to be paid with a use of a voucher. DIHs are in the centre of the ecosystem where education and research meet with business. Thus, DIHs should be better positioned to design such courses, while trainers could come from DIHs members representing both worlds – academia and business.

4.5 Unique value proposition

The DIH concept is often unclear to stakeholders. Companies and even business support entities do not understand the idea behind DIHs, its novelty and do not notice elements distinguishing DIHs from e.g. competence centres. DIHs are most often networked organisations with many partners, from different sectors and providing a variety of services. To a company which is less used to this environment, it can be perceived as very complex and unclear. It takes time and effort to explain to stakeholders what the benefits of working with DIHs are as compared to other entities already present in the market.

During the project implementation, we noticed significant improvements in the awareness level of public stakeholders in terms of DIHs. This is attributed to a large effort of the European Commission to promote, explain and support DIH's concept and to other ongoing initiatives including I4MS, SAE and the Smart Factories project itself. Nevertheless, there is still lots of work to be done to make DIHs publicly recognised.

Recommendations:

1. Develop a DIH brand

Efforts of the European Commission to promote the DIH concept among policy-makers and national authorities should be supported with marketing activities aiming at establishing a well-recognised brand of DIH. A communication strategy with a clear action plan should be developed to present a systematic approach to building the brand among potential customers of DIHs across the EU. The main focus should be on benefits for companies resulting from working with DIHs. The marketing strategy could offer elements such as a set of consistent communication messages and common branding potentially with one logotype to support visual identity and recognition.

As part of the DIH branding, the European Commission could establish a contest for most successful DIHs in a number of categories. The contest could also award not only DIHs, but also national and regional authorities for their efforts to support DIHs and the digitalisation of the industry.

2. DIH certification

One of the points discussed during the Project's activities was the issue of certifying DIHs by national authorities or by the European Commission. This is partly covered by the DIH Catalogue, which offers a list of DIHs across the EU. However, due to relatively broad criteria for acceptance of DIHs to the list and often declarative character of data presented, it has limited potential for promoting the concept of DIHs.

Many stakeholders claim that being called a DIH does not bear deeper meaning. This is due to the fact that criteria for being a DIH¹⁷⁰ are not widely known and there is no system of certification. It might be necessary to set clearer rules and expectations for organisations which pretend to becoming the fully operational DIHs. A pan-European or national systems of DIH certification should also be reconsidered. A more streamlined approach would ensure that the investment made in DIHs is not wasted by a lack of common standards or quality of services offered by DIHs to companies.

In practical terms, the European Commission and national authorities through the Digital Europe Programme will support European Digital Innovation Hubs. Those DIHs will be required to meet specific eligibility criteria set out in the Programme. The requirements should be multidimensional and cover legal (legal status, approach to profitability), financial (economic and financial standing including liability coverage) and business aspects such as breadth and width of services offered, competencies covered and networking opportunities facilitated. DIHs meeting the criteria would be granted a certificate which could be used to strengthen their brand building efforts.

3. Co-creation networks

The European Commission and the European Parliament have been supporting initiatives aiming to build a network of DIHs. Direct forms of support are certainly of high value to DIHs offering unique opportunities to selected consortia. There are also online instruments facilitating collaboration between DIHs such as online platforms and catalogues. The "Co-creation networks" idea wants to establish a cross-sectoral exchange in different regions and hubs. Those networks would bring together different actors, such as researchers, policymakers, entrepreneurs and the public. They aim to share knowledge and create value in a given domain by co-creation methodology. At first it could be an online platform used to build a community and kick-off face-to-face collaboration and exchanges of ideas between main stakeholders (regional actors, policy makers, research institutions, business and citizens). It could take form of regular meetings in a variety of formats from TED-like presentations, through speed-dating and world cafes to design-thinking workshops and hackathons. The main objective would be to create marketplace of ideas and solutions to facilitate the uptake of new technologies in SMEs operations and products.

¹⁷⁰Digital Innovation Hubs Catalogue (<http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-catalogue>) sets out the following criteria for being considered a DIH:

- Be part of a regional, national or European policy initiative to digitise industry;
- Be a non-profit organisation;
- Have a physical presence in the region and present an updated website explaining the DIHs' activities and services provided for the digital transformation of SMEs/Midcaps;
- Have at least 3 verifiable examples of how the DIH has helped a company with its digital transformation.

5 Recommendations for improving the competitiveness of the industrial sector in EU13

In this chapter, we summarise the lessons learned from best practices in the EU15 at the level of the European Union, the Member State and the regions. EU13 countries can make use of these lessons to adjust their policies and build on current uptake of best practices. Where policy makers in the EU13 are taking up these lessons, we mention them as far as they are made public. We summarise options for the implementation of lessons learned at the European Union, the Member State and the regional level.

5.1 Policy recommendations on the EU level

5.1.1 Lessons learned from the implementation of current European initiatives

From various European digitalisation initiatives lessons can be learned how industrial competitiveness of SMEs can be improved. The initiatives are as well originating from the European Commission actions, as well as generated by bottom-up processes between Member States and between digital innovation hubs themselves.

Networking between Digital Innovation Hubs is a means to bridge the experience gap for Digital Innovation Hubs in the EU13: The EU has already a rich experience with cooperation between Digital Innovation Hubs. Through Horizon 2020, the European Structural and Investment Funds and through targeted Coordination and Support Actions, such as I4MS and Smart Anything Everywhere, Interreg projects (eg KETGATE, S34Growth, etc.) and Smart Specialisation Platform thematic partnerships, collaboration between DIHs has borne fruit. In particular collaboration between Digital Innovation Hubs targeting to access resources from outside their country is apparent. A good example is the case of Croatian DIHs asking from assistance from a Swiss Digital Innovation Hub. Together the DIHs combined knowledge from ETH Zürich, the University of Zagreb and the University of Dubrovnik to develop visual inspection of wind turbines for end-user SME Diagnostika, supported in I4MS. Another emerging area of collaboration between Digital Innovation Hubs is development of staff skills. An example is the staff development of the Lithuanian Advanced Manufacturing Digital Innovation Hub (AM-DIH). AM DIH used Erasmus, as well as used Industry 4.0 (in collaboration with the German Innovation Centre Industry 4.0) to develop staff skills¹⁷¹. Initiatives to bring European Digital Innovation Hubs together for collective learning are already brought forward. An interesting example is the initiative for DIH collective learning of the New European Media Initiative (NEM Initiative), one of the European Technology Platforms. Eleven of the NEM members are Digital Innovation Hubs and there are another twenty organisations interested to join a European network on media & content activities. In the Interreg Programme there are Digital Innovation Hubs explicitly asking to connect with other DIHs to access additional facilities, complete

¹⁷¹ Rissola, G. and Sörvik, J., Digital Innovation Hubs in Smart Specialisation Strategies, EUR 29374 EN, Publications Office of the European Union, Luxembourg, 2018, ISBN 978-92-79-94828-2, doi:10.2760/475335, JRC113111.

the missing competencies and develop new services, such as the Basque Digital Innovation Hub (BDIH)¹⁷². Thus, there is room for one or more European instruments allowing DIHs to connect and network for collective learning, exchanging staff, access facilities and develop new services.

Cooperation between regions in the EU15 and EU13 Member States is a good way to replicate policy measures from EU15 to the EU13: Digital Innovation Hubs are inextricably linked with regional innovation strategies. Some of the developments of Regional Innovation Strategies are supported by Digital Innovation Hubs and some Digital Innovation Hubs are the result of Regional Innovation Strategies. In Lithuania, LINPRA (DIH coordinator) has prepared a roadmap for a priority area of smart specialisation strategy. And i.e. in South Moravia, North West Romania and East Sweden, the DIHs are the result of their smart specialisation strategies. Moreover, in some regions Digital Innovation Hubs are hosted by Regional Development Agencies, like in Upper Austria, Wallonia and South Moravia. DIHs are thereby adding a new dimension to the innovation support system, by making available support easier accessible and better understandable for potential beneficiaries. The lessons learned from similar experiences are distributed unevenly over Europe and are only partially documented, i.e. in the Digital Transformation Monitor. Cooperation between regions on smart specialisation strategies could help in transferring best practices in policy learning between regions in the EU 15 and the EU13. In the EU13 there is fertile ground for such collaboration as demonstrated by the Hungarian Institute for Computer Science and Control (SZTAKI). The Hungarian Institute is actively looking for collaboration to take advantage of the lessons learned from German initiatives, as the national programme (Industry 4.0 National Technology Platform) is shaped according to the German model.

Awareness raising of SMEs is most effective at regional level: SMEs take foremost advice from trusted regional sources. Therefore, they are best reached at regional level. An example is the policy measure Made Different in Wallonia. It is geared to the needs of at least fifteen hundred SMEs in Wallonia and has been able to reach out to more than five hundred SMEs already. Such initiatives are under way in the EU13. In an attempt to raise cohesion of ICT adoption, the Hungarian government has launched two programmes to reach SMEs located in peripheral regions. European Cluster organisations can play an important role in awareness raising to SMEs. The “European Strategic Cluster Partnerships for smart specialisation investments” (ESCP-S3) action of COSME created 4 partnerships dedicated to digitalisation, all with clusters from the EU13 (Hungary, Latvia, Lithuania, Poland, Romania and Slovenia). These partnerships reach out to respectively 450 SMEs (Track), 500 SMEs (Cyber Secure Light), 771 SMEs (DIGICLUSTERS) and 1000 SMEs (Connsensys). Through these projects clusters demonstrate their role in technology intelligence, smart specialisation and value chain integration. Another organisation that can play a role in reaching out to SMEs is the Europe Enterprise Network EEN. So far EEN has not provided specific digitalisation services, but has a track record in reaching out to 50,000 companies per year and has reached out to 10,000 companies benefitting from tailor made innovation support services, since 2014.

The European ambition level of having at least one Digital Innovation Hub per region in 2020, is only attainable with new or adapted policy instruments: The European Commission has defined the role of the Digital

¹⁷² <https://www.interregeurope.eu/policylearning/good-practices/item/497/basque-digital-innovation-hub-bdih/>

Innovation Hubs in the future Digital Europe Programme¹⁷³, and expressed the ambition of having at least one Digital Innovation Hub per region in 2020. So far the establishment of Digital Innovation Hubs in the EU15 has been incentivised through Horizon 2020 actions like I4MS and Smart Anything Everywhere. These measures require scientific excellence, which the EU13 have difficulties to reach, as most of the EU13 Member States are still in the technology adaption phase. The overall EU13 participation in the Horizon2020 is considerably lower than that of the EU15¹⁷⁴. And so far, the option to use funds from the European Regional Development Fund in the EU13 has only been used by Digital Innovation Hubs in Poland, Slovenia and Latvia. And the usage of the European Social Fund is limited to Estonia. New or adapted policy instruments will be needed to set up Digital Innovation Hubs in the remaining 140 regions. Therefore, additional measures are needed to establish Digital Innovation Hubs in the EU13.

5.1.2 Possible implementation options of best practices

Set up a Digital Innovation Hub Platform to highlight idiosyncrasies: In addition to the mapping of Digital Innovation Hubs on the Smart Specialisation Platform, a platform is needed to facilitate networking between Digital Innovation Hubs, which accelerates partnering and knowledge sharing among digital innovation hubs, their enterprise members, their knowledge institutes and their governmental organisation across Europe. Such a platform could take the form of an on-line hub, like the European Cluster Collaboration Platform. The Digital Innovation Hub Platform should include an interactive map showing the DIHs, the EEN nodes, clusters, science parks and incubators and should have a partner search tool. The platform should enable SMEs to search for DIHs in a catalogue of services, which has been empowered by the Digital Innovation Hubs themselves. The platform could also contain a list of experts, who have qualified to provide digitalisation services to SMEs. The platform should incentivise regional cooperation between DIHs and should actively link to national network initiatives, such as the Thessaloniki Innovation Hub in Greece and the Digital Innovation Hub Świerk in Poland. In Greece the Thessaloniki Innovation Hub builds such a network between innovation actors: research institutes, incubators, universities, co-working spaces and businesses adding start-ups to the innovation eco-system. In the EU13 other specialities arise, such as the niche approach of the Digital Innovation Hub Świerk in Poland, where support towards digitalisation is channelled to companies active in the energy, nuclear and chemistry sectors. A European Digital Innovation Hub Platform could also play an important role in public sector digitalisation by including Innovation Labs and Policy Labs, which are mostly active in designing new user-centred public services, but which are not yet connected into a European network.

Set up a dedicated SME Digitalisation Instrument: The successful SME Instrument of DG Grow could be replicated into a specific digitalisation instrument for SMEs. Rather than focussing on excellent innovation (such as the cascading funding in Horizon2020), the instrument should focus on improving the level of digitalisation transformation within firms. The SME Digitalisation Instrument should have a mandatory involvement of a Digital Innovation Hub of choice. Lessons could

¹⁷³ Digital Innovation Hubs, DG Connect, December 2018, Digital Innovation Hubs in the Digital Europe Programme: <https://ec.europa.eu/futurium/en/digital-innovation-hubs/digital-innovation-hubs-digital-europe-programme>

¹⁷⁴ Overcoming innovation gaps in the EU-13 Member States, European Technology Assessment Group (ETAG), Directorate-General for Parliamentary Research Services (DG EPRS) of the European Parliament, ISBN 978-92-846-2660-1, March 2018.

be learned from the experiences of Manufacturing Advisory Services (MAS) in the UK, which run between 2002 and 2015. Between 2002 and 2008 MAS was able deliver more than £400 million in added value for manufacturing companies across the UK. The MAS was carried out by the Regional Development Agencies and had 5 levels of intervention: Initial contact, Review, Awareness and Training events, Consultancy support, Signposting and Referral. Companies could apply for the review and receive it without payment. However, the most labour intensive part of the programme (up to 10 days per company), was provided only with a company support of 50% of the budget. Thanks to this company contribution, the SME Digitalisation Instrument can leverage the access to finance. Independent certification of the company achievement by the SME Digitalisation Instrument could help both SMEs in obtaining investment and the DIHs involved in reaching out to potential investors. A critical element to motivate the SMEs is the collection of success stories on a dedicated DIH platform, in the way it is done by the European EU-Gateway | Business Avenues programme. The success stories could contain the lessons learned from the Horizon2020 Innovation Actions.

Create DIHs in every region by setting up a dedicated DIHs excellence impact programme, in which the outreach to SMEs is incentivised: In the context of the European Cluster Excellence Initiative a benchmarking methodology was created for cluster organisations, resulting in a certification by gold, silver and bronze labels. Such a labelling system will require the establishment of a set of quality indicators (structure, organisation, finance, strategy, achievements) to which Digital Innovation Hubs have to adhere. By incentivising the SME outreach, the group of potential host organisations for DIHs will be broadened to Regional Development Agencies, Clusters, Science Parks and Incubators. The labelling system has to be guarded by an independent organisation (accreditor), and another organisation should be made responsible for certification (certifier). Such a certification programme could help improving the quality level of Digital Innovation Hubs. The best quality level should be given to the Digital Innovation Hubs with the capability to integrate SMEs into cross-border European value chains.

Ensure continuous and collective learning for Digital Innovation Hubs, in a similar fashion as was provided in this project. In pilot projects to mentor and coach Digital Innovation Hubs such as DIHELP there is a lack of recognition for the maturity level of Digital Innovation Hubs. A DIH Excellence framework can overcome this and enable mentoring and coaching up to the life cycle of the Digital Innovation Hubs. A Digital Innovation Hub Platform could provide a central repository of common training tools, and could provide a repository of unique digitalisation facilities in Europe. A dedicated skills exchange scheme should be developed after the example of Erasmus for Young Entrepreneurs or ClusterXchange schemes. The exchange of good practices could be further supported by DIH workshops, which could be dedicated to specific technologies, such as Artificial Intelligence, High Performance Computing and Cybersecurity. Another topic for the DIH workshops could be value chain integration in i.e. Agriculture and Food Supply Chains, in Autonomous Driving and in Sustainable energies.

Set up a Task Force for the Digital Agenda in the EU13, under the European Platform of National Initiatives: Policy makers in the EU13 need support in funding their Digitising Industry Policies. In coordination between them and with European Financial Institutions, they can take advantage of opportunities to mobilise ESIF funds for the Digital Agenda. They can find the guidelines to specify their policies

already with the Digital Agenda Toolbox¹⁷⁵ of the Smart Specialisation Platform. This Toolbox can also help them to ensure that the national Operational Plans for the European Structural and Investment Funds reflect their digitisation ambitions and that sufficient investment funds are earmarked for structural investments in facilities for Artificial Intelligence, High Performance Computing and Cybersecurity.

5.2 Policy recommendations on national level

Ensure that a national digitisation policy is in place: All EU15 have a digitisation policy in place, where the EU13 are in various stages of digitisation policy development:

- A policy in place with varying degrees of success (CZ, EE, HU, LV, LT, PL)
- A policy in development (HR, BG, CY, RO, SK, SI)
- No initiative (MT)

The German initiative Go Digital reveals that national policies are most successful when the national policies set clear goals and have a straightforward action plan. In the EU13 digitisation policies are often not amongst top policy priorities, which has led in Croatia to digitisation priorities incorporated in the state aid act for research and development and in the investment promotion act. And in Bulgaria digitisation policies are channelled through the National SME Promotion Strategy 2014-2020.

National Initiatives for Digital Innovation Hubs are a game changer: All EU 15 have national initiatives to support Digital Innovation Hubs. In the Netherlands, this is done by the creation of field labs, which are financed through private funding. In Germany, the "Industry 4.0 Competence Centres" play this role. In the EU13, Poland, Estonia, Hungary, Slovenia and Bulgaria support the function of Digital Innovation Hubs via national initiatives. Other countries are still at the beginning of this journey.

The establishment of Digital Innovation Hubs needs support from actors resulting from innovation policy: The Greek Digital Innovation Hub ARIC clearly demonstrates that a Digital Innovation Hub can only thrive well if it can connect and work closely together with innovation actors like clusters, new market enablers, innovation infusers, business incubators, educational bodies, internationalisation enablers and access to finance providers. Along this line, the Polish Digital Hub Świerk has developed partnerships with the University of Warsaw, large actors in the Polish energy market as well as with SMEs and local authorities. Estonia, Hungary, Latvia and Bulgaria have also taken significant steps towards this direction.

Cooperation between various ministries, employment organisations and trade unions should be possible: The case study of Comiflex (SE) and Skills Bridge (LU) show that these policy measures can only advance with the support of a tripartite agreement. The Sofia Tech Park in Bulgaria is following these lessons and is setting up partnerships with the academia, the business community, business clusters, the local municipality, ministries for education and for labour, and NGOs.

SMEs need incentives to convince them to work on digitisation: In Italy the vouchers for digitisation have been requested by 92,000 SMEs of which only 10,000

¹⁷⁵ <http://s3platform.jrc.ec.europa.eu/dae-toolbox>

can be honoured. This shows that there is a real need for funding support and that authorities need to manage these demands.

Platforms for the exchange of information and experiences are necessary to reach the SMEs: Digital platforms are necessary tools to reach out to as many SMEs as possible. These platforms need to be client friendly and easy to use. The most efficient way would be to set-up a European DIH platform, which links to national initiatives in which DIHs are engaged. Such a national platform has been set up in Greece with the Thessaloniki Innovation Hub.

Communication and dissemination are essential to keep the interest high: Awareness raising campaigns together with an available helpdesk built trust with SMEs and improves the impact of digitisation measures. The Comiflex measure in Sweden has used such a combination.

A dedicated implementation body has to be in charge of the digitisation policy: In France the dedicated SME Agency JESSICA in charge of the implementation of digitisation measures has been successful for many years.

A mixture of private and public funding improves the possible impact of a digitisation measure: In the Netherlands regional governments support the so-called Fieldlabs together with private investors offering mostly in-kind support. The thirty-two Fieldlabs are part of the national Smart Implementation Agenda 2018-2021. In the EU13 there are very few examples of privately and publicly co-financed Digital Innovation Hubs. An exception is the Sofia Tech Park, which is a state-owned company that acts as a Digital Innovation Hub and is funded by the park's internal resources, research projects and industrial projects.

Ensure the national digitisation policy has a strategy and a realistic action plan: The development of a national digitisation plan should start with awareness raising campaign and should early on determine the main actors to be involved in advising companies. In Spain, the Activa Industria 4.0 is part of the Spanish National Initiative Industria Conectada 4.0, which is seamlessly setting up advisory services after its awareness raising campaign involving regional stakeholders.

Set up an information and communication platform: The main stakeholders need to meet physically to agree on a common agenda. Local meetings and a digital platform should reach the targeted companies. A good practise example is the Comiflex initiative in Sweden.

Set up a public private partnership, which will ensure funding and support for Digital Innovation Hubs: In Germany, the twelve Digital Hubs are mandated to form strategic alliances with private actors at regional level. These actors can be industry associations, clusters or individual companies.

5.3 Policy recommendations on regional level

Regions have to be mandated by the national government to be active in digitisation policy measures: In Germany the federal states play an important role in rolling out the Industry 4.0 policy and the national government has mandated them to do so. Within the EU13, Romania has adopted an approach closest to this through the establishment of regional development agencies (Agenția pentru Dezvoltare Regională).

Peer-to-peer networks are essential to learn from best practices and to motivate companies in adopting digitisation strategies: In Belgium the so-

called ambassadors, which represent leading successful cases of digitalisation in business, lay a crucial role in the Made Different initiative. These ambassadors represent leading successful cases of digitalisation in business. Poland and Latvia offer good examples of EU13 countries that successfully support the functioning of Hubs through networks.

Advice on digitisation needs the inclusion of regional stakeholders to create the trust needed by companies: The Austrian SME Digital Funding Program (KMU Digital Förderprogramm) engages regional organisations and advisors to roll out the programme at regional level. The Digital Freedom Festival in Latvia brings together policymakers, investors and digital entrepreneurs with the aim to discuss the impact of technology on daily life.

Policy measures need to take into account the individual affected employees: In the Luxembourgish initiative Skills Bridge, the role of the individual employee has been recognised as a key success factor for the implementation of the pilot programme.

Regional specificities have to be taken into account for regional measures: In preparation of the German Digitisation and Innovation vouchers (Innovationsgutscheine und Digitalisierungsgutscheine), the needs of SMEs were mapped, which is continued to be monitored during implementation.

For upskilling and reskilling skill development a combination of technical skills and soft skills is necessary: In the Luxembourgish initiative Skills Bridge, given the new competences required upskilling in the digital age, the need for developing of soft skills in addition to technical skills has become apparent. Both Hungary (Digital labour force programme, Industry 4.0 Model Factories, Industry 4.0 Technology Centre) and Latvia (LIDA, State Education Development Agency courses) have adopted this approach in their upskilling/reskilling programmes.

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