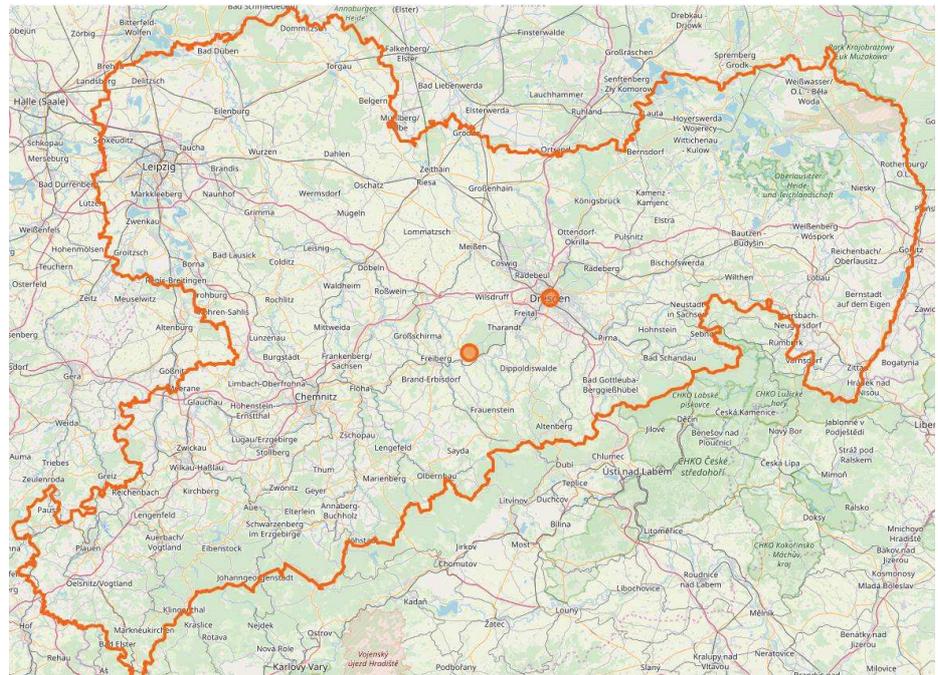


ACTION PLAN SAXONY



10/25/2018

REGIONAL ACTIONS TO INNOVATE OPERATIONAL PROGRAMMES (RATIO)

Based upon analysis and developed out of the project RATIO the following actions are recommended. They are located within the three areas of Digitalization, Innovation and TECHNOLOGY TRANSFER from higher education and Skills shortage in STEM subjects.

action plan Saxony

REGIONAL ACTIONS TO INNOVATE OPERATIONAL PROGRAMMES (RATIO)

Content

BACKGROUND – SHORT CHARACTERIZATION OF THE SAXON ECONOMY	2
DIGITALIZATION	4
Situational analysis	4
Recommended Actions	6
Action 1: Make FÖMISAX transparent.....	6
Action 2: Innovation Link Portal	9
Action 3: E-Commerce micro grant	12
INNOVATION AND TECHNOLOGY TRANSFER FROM HIGHER EDUCATION	14
Analysis and Background	14
Recommended Actions	20
Further Actions	25
SKILLS SHORTAGE IN STEM SUBJECTS	27
Analysis and Background	27
Recommended Actions	35
Action 4: Training and Development	35

BACKGROUND – SHORT CHARACTERIZATION OF THE SAXON ECONOMY

Saxony is considered one of the strongest economic states in East Germany. This can be seen in the increase in gross domestic product of 61% in the years 2000 to 2017 (by 28% in the years 2010 to 2017), whereby the gross domestic product is also the highest among the new federal states.¹ The following section provides a brief overview of the situation in Saxony with regard to various economic indicators and classifies the results into a West and East as well as an all-German context. Furthermore, regional characteristics within Saxony are shown.

Saxony's gross value added was 85.5 billion euros in 2010, compared to 109.7 billion euros in 2017². Thus, an increase of 28.3% was recorded. The change for East Germany in this period is 24.9%, for West Germany 26.6%.³ The gross value added per employee was for Saxony in 2010 43.301 euros and 2017 53.409 euros. With 263 euros, Saxony is thus slightly below the average value added per person employed in 2017 in Eastern Germany (53,672 euros per person in employment), and also below those for western Germany (68,676 euros per employed person) and Germany (66,403 euros per employed person) (cf. VGRdL). Looking at the rates of change in gross value added per person in employment for the years 2010 and 2017, Saxony is also below the average here compared to a growth of 6.2% (East Germany: 7.2%, West Germany: 7.4% and Germany 7.3%) (see VGRdL).

The unemployment rate in Saxony was 11.8% in 2010 and 6.7% in 2017.⁴ In total, 43.2% fewer persons were unemployed in 2017 than in 2010. Saxony, thus, has the strongest decline in the number of unemployed persons in comparison to East Germany (-36.7%) and West Germany (-19.7%) as well as the entire Federal Republic (-26%). The unemployment rate in 2017 is still below the Eastern German value (7.6%), but above the unemployment rate in West Germany (5.3%) and Germany (5.7%). In 2010, 1.98 million people were in employment in Saxony, which increased by 4% to 2.05 million by 2017. Thus, Saxony was again better than the entire East German region (1.7%) but remains under the developments for West Germany (8.7%) and the whole of Germany (8%) (see VGRdL).

For Saxony, the balance of trade registration and deregistration in 2010 is 3,539, in 2017 it is -1,750.⁵ In 2010 this corresponds to a balance of trade registrations and deregistrations of 1.7 per 1,000 employed persons and in 2017 a balance of trade registrations and deregistrations of -0.8 per 1,000 gainfully employed persons. In Germany the balance is 149,174 in 2010 and 39,462 in 2017. The balance per 1,000 employed persons is twice as high for Germany in 2010 with a value of 3.6 per 1,000 employees as it is for Saxony. In 2017 it is 0.9 per 1,000 employed persons for Germany.

Looking at the indicators related to the counties and municipalities of Saxony, it is noticeable that in the district of Central Saxony the total gross value added could be increased by only 1.3% in 2010 and 2014, in the City of Leipzig the change is 27.6%. Also, the gross value added per employee in the industry without construction industry is for the city of Leipzig (85,101 euros per worker), but also for the county of Leipzig (82,653 euros per worker) to highlight, because these are in 2014 almost at (West) German level (West Germany: 86,535, Germany: 83,680). In terms of the chamber districts, it is

¹ Vgl. Volkswirtschaftliche Gesamtrechnungen der Länder (VGRdL), Statistische Ämter der Länder: <https://www.statistik-bw.de/VGRdL/tbls/?lang=de-DE>; zuletzt geprüft am 18.09.2018.

² Vgl. Statistisches Landesamt des Freistaates Sachsen: <https://www.statistik.sachsen.de/html/866.htm>; zuletzt geprüft am 18.09.2018.

³ Vgl. Statistisches Bundesamt: <https://www.destatis.de/DE/ZahlenFakten/Indikatoren/LangeReihen/Arbeitsmarkt/larb001.html>, zuletzt geprüft am 18.09.2018.

⁴ Vgl. Statistisches Landesamt des Freistaates Sachsen: <https://www.statistik.sachsen.de/html/866.htm>; zuletzt geprüft am 18.09.2018.

⁵ Vgl. Statistisches Landesamt des Freistaates Sachsen: <https://www.statistik.sachsen.de/html/715.htm>; zuletzt geprüft am 19.09.2018.

noticeable that the Leipzig chamber district has the strongest rate of change in terms of gross value added in all sectors, including the non-regional industries such as manufacturing (including construction).

The highest unemployment rate was recorded in the chamber District Leipzig in 2010 (13.1%), in the chamber district Dresden (10.6%) and Chemnitz (10.3%) it was slightly lower. Although the chamber district Leipzig still has the highest unemployment rate of 8.2% in 2016, the proportion of the district of Dresden (7.6%) is at a similar level, the Chemnitz district (6.4%) remains below it. However, the unemployment rate in the chamber District Leipzig fell the most. The absolute number of unemployed in this period, compared to the other chamber districts, was reduced the most in the district of Chemnitz: In 2014 30.4% fewer people were unemployed than in 2010. With regard to the employment figures for the Chemnitz district, however, there is also a decline trend: Here, too, fewer persons were employed in 2014 than in 2010. This means that although the number of unemployed persons in the Chemnitz district was the strongest, no increase in the number of persons in employment could be achieved at the same time. In the two other chamber districts this trend does not appear. This could mean that unemployment was reduced in the chamber districts of Leipzig and Dresden by the creation of new jobs. In the district of Chemnitz, reasons of a spatial (e.g. withdrawal) or natural population development (e.g. age) may play a role.

The industry sector of crafts plays a special role in the regions. Its position in the economy can be classified according to the proportion of companies and employees. For Germany as a whole, some 590,000 of the approx. 3.6 million companies are craft trades in 2014, which corresponds to 16.1% of all companies. In the new federal states, the proportion is significantly higher at 19.3%, in Saxony the proportion is on average even at 22.7%. The counties, in which more than every 4th company constituted a craft business, i.e. accounted for more than 25%, are: Erzgebirgskreis (28.8%), Vogtlandkreis (27.3%), Bautzen (27%), followed by Görlitz and Sächsische Schweiz-Osterzgebirge (26.7% each), Mittelsachsen (25.8%) and Zwickau (25.3%). The share of handcrafts to social security contributions is slightly lower. In Germany, 13.4% of all employees work in a craft business, in Saxony, this is 19.4% of all employees – every fifth employee subject to social insurance in Saxony works in the trades. Looking at the districts, the Erzgebirgskreis (20.1%) is at the top again, followed by Leipzig (18.9%) and Mittelsachsen (18.2%).⁶

Correspondingly, the handcraft has a great regional economic significance for the spaces beyond the metropolises. Craft companies are distributed decentrally in the region. This means that they also have an above-average presence in rural-peripheral and structurally weak regions. In 2013, 38.3% (compared to 30.1% of all enterprises) of the handicraft enterprises were located in rural areas, 29.3% (compared to 22.4% of all enterprises) in peripheral regions and 16.7% (against 11.16% of all enterprises) Companies) in above-average shrinking regions. This shows that the craft is currently represented in the regions that are of particular interest to economic and regional policy. If instruments for the reduction of spatial parities are to be developed, craftsmanship plays an important role in these regions as a clearly disproportionately represented group of companies.

⁶ Müller, Klaus (2017) Die Stellung des Handwerks innerhalb der Gesamtwirtschaft S. 111.

DIGITALIZATION

Situational analysis

INTRODUCTION

Digitalization has become a buzzword over the last years and is often related to phrases like digital transformation and digital industrial revolution. Eventhough the word of digitalization is frequently used, there is not only one definition accepted in the literature. Within RATIO, our understanding of digitalization goes along with the following broad understanding: Digitalization describes the comprehensive connection of all fields from industry to society. It gives the ability to gather, analyze and process relevant information. Digitalization causes both chances and challanges.⁷

As a result of RATIO's phase 1, we are convinced that digitalization as a cross-sectional technology is key to meet the challanges identified in Saxony⁸. Those challanges were collected via interviews conducted at the stakeholder meetings and via the Innovation Health Care Tool, a survey tool by Interprise Ireland, at the beginning of Phase 1. The most frequently mentioned challanges are:

- Lack of information on funding opportunities
- Lack of financial resources and funding instrumens for innovation support
- Lack of skilled employees.

ADDRESSED POLICY INSTRUMENT

The actions related to digitization aim to impact the Innovation strategy of the Free State of Saxony (2013) (Innovation strategy) as a regional development policy instrument. The authority responsible for this Innovation strategy is the Saxon State Ministry for Economic Affairs, Labour and Transport.

GAP

First, the Innovation strategy does not differentiate for its actions between urban and rural areas. This is critical because the four major Saxon urban areas around the cities of Leipzig, Dresden, Zwickau and Chemnitz strongly differ in its characteristics from the rural areas in terms of population and economic activities. The main driver of Saxony's economic development are the urban areas. The four biggest cities account 41,7% of the population but only 9,7% of the whole area in 2017⁹. Apart from these four cities, almost all areas are considered as rural areas, according to the definition of the LEADER program. This importance of rural areas is not mirrored in the Innovation strategy. There are only three sections in which they are mentioned:

- 1) In rural areas innovation must be fostered ti maintain services for the public.¹⁰
- 2) Rural areas are also part of a pilot scheme for e-mobility taking place in the two neighboring states of Saxony and Bavaria.¹¹
- 3) In rural areas reception of mobile data (LTE) is considered as advanced.¹²

⁷ ("Industrie 4.0 und Digitale Wirtschaft," 2015, p. 3)

⁸ Haucap and Heimeshoff (2017, p. 46)

⁹ Please see <https://www.statistik.sachsen.de/html/426.htm>, retrieved on 07.10.

¹⁰ Staatsministeriums für Wirtschaft, Arbeit und Verkehr (2013, p. 58)

¹¹ Staatsministeriums für Wirtschaft, Arbeit und Verkehr (2013, p. 68)

¹² Staatsministeriums für Wirtschaft, Arbeit und Verkehr (2013, p. 72)

Hence, policy actions tailored to the specific characteristics of both urban and rural areas is our recommended starting point for improvements.

Second, the Innovation strategy has several interfaces with other state strategies, e.g. *Skilled employees strategy Saxony 2020*, *Small and Medium sized Enterprises program* and *IT and E-Government strategy*.¹³ However, there is no specific strategy addressing digitalization. In fact, the word “digitalization” is not even mentioned once in the Innovation strategy. With reference to the relevance of digitalization for all RATIO project partners, and thus Germany too, we recommend including the topic of digitalization as cross-sectional technology in the upcoming Innovation strategy. As we know from the literature and from the RATIO project, digitalization affects almost all industry sectors, such as agriculture (AgriCon GmbH [DE]), manufacturing (HENNLICH s.r.o. [CZ]) and telecommunications (Spearline [IR]). Therefore, we provide several digitalization-related actions.

Highlighting digitalization’s importance and chances connected with regard to the Innovation strategy is inevitable even though well-known. It is not only us claiming introducing digitalization in the policy program. For instance, a think tank (Exper commission Research and Innovation) advising the German federal government also claimed prioritizing digitalization. In their most recent report they recommend:

- Doubling the digitalization-related funding opportunities by 2025¹⁴,
- Fostering digital education in all fields of education.¹⁵

RECOMMENDATIONS’ OVERVIEW

Subsequently, we present an overview of the recommendations we propose stemming from the RATIO project.

Reported challenge	Recommended action	RATIO reference
<ul style="list-style-type: none"> ▫ Lack of information on funding opportunities ▫ 	<ul style="list-style-type: none"> ▫ Action 1: Make FÖMISAX transparent 	<ul style="list-style-type: none"> ▫ BioCurve, S.L. (ES) ▫ AgriCon GmbH (DE) ▫ HENNLICH, S.R.O. (CZ)
<ul style="list-style-type: none"> ▫ Lack of information on funding opportunities ▫ 	<ul style="list-style-type: none"> ▫ Action 2: Innovation Link Portal 	<ul style="list-style-type: none"> ▫ ITAINNOVA (ES) ▫ Enterprise Ireland (IR)
<ul style="list-style-type: none"> ▫ Lack of financial resources and funding instruments for innovation support ▫ 	<ul style="list-style-type: none"> ▫ Action 3: E-Commerce micro grant 	<ul style="list-style-type: none"> ▫ Innovation Vouchers, esp. by Ústí Region (CZ)
<ul style="list-style-type: none"> ▫ Lack of skilled employees. ▫ 	<ul style="list-style-type: none"> ▫ Action 4.1. Company Health Check 	<ul style="list-style-type: none"> ▫ Innovation Health Check Tool by Enterprise Ireland (IR)
<ul style="list-style-type: none"> ▫ Lack of skilled employees 	<ul style="list-style-type: none"> ▫ Action 4.2. Hire an expert 	<ul style="list-style-type: none"> ▫ R&D personnel funding program [DE])*

¹³ Staatsministeriums für Wirtschaft, Arbeit und Verkehr (2013, p. 12)

¹⁴ Expertenkommission Forschung und Innovation (2018, p. 22)

¹⁵ Expertenkommission Forschung und Innovation (2018, p. 9)

□ Lack of skilled employees	□ Action 4.3. Learning networks	□ Skillnet (IR)
□ Lack of skilled employees	□ Action 4.4. Digitalization scout	□ Hennlich S.R.O. (CZ)
□ Lack of skilled employees	□ Action 4.5. ICT driver's license	□ School with Class 2.0 (PL)* □ Coding Masters (PL)* □ #SuperCoders by Orange* □ Devoxx4Kids (DE)*

* References from RATIO stakeholders but no acknowledged RATIO good practices.

Recommended Actions

Action 1: Make FÖMISAX transparent

Introduction

One of the main challenges identified in RATIO for some of the project partner regions, but especially for Saxony, is a lack of information on funding opportunities. In this case, lack of information means a lack of easily accessible and clearly structured information on the one hand and a lack of transparency on the other hand. The reported lack of clearly arranged information is no surprise because there is no comprehensive database covering most of the public funding programs.

In Germany, most of the public funding is issued by the government and the 16 provinces (Bundesländer) due to the federal system. On national level, there is one central database for national public funding (foerderdatenbank.de). However, there has been no agreement on feeding the national funding database with information from the federal funding programs yet.¹⁶ Luckily, most of the Saxon authorities administering provincial public funding (e.g. Sächsische Aufbaubank, Saxon Ministries, Saxon agencies and state-owned enterprises) send their information to the national funding database. Hence, one can find almost all funding programs addressing entities in Saxony by using one database. Nevertheless, Saxony runs its own funding database (FÖMISAX-Fördermitteldatenbank Sachsen) consisting of the provincial funding programs. So, there is a public duplicate structure.

In addition to the public duplicate structure, there are several other commercial databases (e.g. landesfoerdermittel.de or deutschland-startet.de) providing information on funding programs. The business model of these databases is built on the public duplicate structures. By providing additional databases, information on public funding programs becomes even more confusing. On top of the described public duplicate structure, the Saxon authorities administering public funding programs have, in turn, their own databases providing information on their specific funding programs.

Finding appropriate funding programs is only the starting point of the journey through the funding jungle. Once the programs are found, the lack of transparency hinders companies on several stages. First, there is often crucial information between the lines. Second, there is often no information on overall budget, remaining budget, number of applicants or the probability of approval. Thus, it is hard to decide on whether it is worth the application's effort. Moreover, there is often no information on processing time of the application or even on the availability of the payment.

¹⁶ Schmotz (2018).

Background

The lack of funding information has been both identified and acknowledged by most of the project partners. So, it has been content of several discussions during the exchange of experience meetings. Some of RATIO's policy stakeholders, e.g. Dr. Robert Weigelt, a cluster manager of the Thuringian regional development company, argued that this lack of information might cause to some extent the relative obscurity of some programs. This obscurity, in turn, might be one reason for some funding programs' underspending. Even amongst RATIO's good practices and study visits there have been some representatives pointing out this lack of information. In the following, there are three RATIO examples which solved this challenge in different ways.

First, BioCurve, S.L. (ES) [study visit] hired a company for helping with raising public funding. Second, AgriCon GmbH (DE) [Good practice] employed a half-time equivalent for procurement of funding at the time. Third, HENNLICH, S.R.O. (CZ) [study visit] took advantage of funding advice by the Ustí innovation center.

These three examples of innovation and entrepreneur-award winning companies show that there seems to be the need of a helping hand when dealing with public funding programs. Fortunately, there are institutions in Saxony providing this help for free, at least to some extent, e.g. the Chamber of industry and commerce or Enterprise Europe network groups. However, funding advisories is only one solution to this challenge. We recommend a solution tackling the challenge of the lack of information on public funding opportunities by its roots.

Action

- Extend the database to provide further, up-to-date information for the Saxon funding database, esp. on program's total budget, remaining budget, number of last period's applicants, average probability of approval, average application processing time and expected date of funding availability.
- Do not hide information written between the lines, e.g. favored applicant's field of activity.
- Do not withhold information in the call which is presented during the funding program's roadshow.
- Improve the database's search and filter options and, thus, allow more tailored search for information.
- Advertise the new transparent Saxon funding database with a company-targeted marketing campaign using different channels, e.g. internet, radio and trade fairs.¹⁷
- Moreover, develop an inter-departmental commercialisation collaboration partnership supporting the optimization of government spending on technology development and commercialization. This will reduce any unnecessary duplication of funding efforts.¹⁸

Outlook

Once the national database for public funding displays the full information provided by the respective provincial authorities in a harmonized manner, abolish or at least put offline the provincial database "FÖMISAX-Fördermitteldatenbank Sachsen". This will reduce the public duplicate structure in first place and, in addition, will save the provider of the FÖMISAX database resources.

¹⁷ For an outside-RATIO reference please see: Thüringer Ministerium für Wirtschaft, Wissenschaft und Digitale Gesellschaft (2018, A20).

¹⁸ For an outside-RATIO reference, please see: Department of Trade and Industry [Republic of South Africa] (2018, p. 95).

Player involved

- **Database provider:** State Chancellery of Saxony (FÖMISAX-Fördermitteldatenbank Sachsen) and Federal Ministry for Economic Affairs and Energy (foerderdatenbank.de)
- Company working on the database's modification, if necessary
- **Authorities administering the Saxon funding programs:** Sächsische Aufbaubank (SAB), Kommunaler Sozialverband Sachsen, Sächsisches Landesamt für Straßenbau und Verkehr (LASuV), Sächsisches Landesamt für Umwelt, Landwirtschaft und Geologie (LfULG), Mitteldeutsche Medienförderung GmbH and Gemeinsames Technisches Sekretariat
- **External marketing agency** running the marketing campaign
- **External market research institute** for evaluating the firm's satisfaction with the database
- All the **16 German state Ministries**

Timeframe and costs

Time	Milestone	External Costs	External Funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Inter-provincial funding information agreement	-	-
2019/04- 2019/07	Database modifications Application programming interface for the authorities providing the information on the several funding programs Database's launch	(EUR 15,000)	t.b.a
2019/08- 2019/09	Database's testing phase	-	-
2019/10- 2019/11	Marketing campaign	EUR 30,000	t.b.a
2019/12- 2020/03	Database's evaluation phase	EUR 40,000	t.b.a
Sum		EUR 85,000	t.b.a.

Action 2: Innovation Link Portal

Introduction

As there has been identified the lack of clarity on funding information, there have been identified three other lacks:

- 2.1. Lack of clarity on information meetings and workshops
- 2.2. Lack of information on competencies for collaboration
- 2.3. Lack of information on usable facilities and equipment.

At the time, there were dozens of activities related to the topic of digitalization (2.1). RATIO stakeholders perceived this amount of activities even as excess supply. This is no surprise because there is no official prior consultation amongst the organizers. Ironically, the organizers are even in competition with each other for attracting participants. As a result, the participants must decide where to go because of overlaps sometimes. So, there is an excess supply on the one hand and a lack of participants on the other hand sometimes.¹⁹ As there is no database consisting of public funding programs on national level, there is not even a comprehensive database for information meetings or further educations in Saxony.

There are platforms for commercial and private goods, e.g. eBay and eBay Kleinanzeigen. There are platforms for freelancers, e.g. upwork.com or freelance.de. However, there is neither a platform for lack 2.2, firms' competencies for collaboration, nor a platform for 2.3, usable facilities or equipment, in German language. here is the database for partnering opportunities by the Enterprise Europe Network. However, it is only in English which is sometimes an obstacle for companies in Saxony. This language issue is well-known since it is even mentioned in the Saxon Innovation Strategy²⁰.

Background

The background of the subsequent recommendation can be read as the continuation of the background story of Action 1: Make FÖMISAX transparent. Its starting point is the Technology Center ITAINNOVA which was visited during the Exchange of experience in Zaragoza (8.-9.3.2018). ITAINNOVA is the Technological Institute of Aragon (ES). It offers three main services to industry, science and public with a clear market orientation:

- Services: information meetings, workshops, vocational training and professional development
- Competences: contract research and development as well as collaboration
- Laboratories: facilities and high-tech equipment.

In order to attract both potential collaborators and customers, they showcase online their competences and equipment pool. So, ITAINNOVA might be considered as a Good practice in terms of offering their services, as we concluded with the other RATIO partners during the study visit. However, their website does not allow interaction, even though it is informative and modern. At this point, the German stakeholder Dr. Robert Weigelt from the Thuringian regional development company stepped in and pointed out a project under development in the neighbour state of Saxony, Thuringia. There, they agreed on developing an online matching platform, called Expertfinder, for competences in the province's digital strategy 2018. Dr. Robert Weigelt informed us that the Thuringian universities (of applied

¹⁹ LandInForm (2017, p. 25).

²⁰ Staatsministeriums für Wirtschaft, Arbeit und Verkehr (2013, p. 48)

sciences) have been encouraged to create an equipment pool with the aim of making it both publicly available and accessible.²¹ However, there is no official commitment or collaboration agreement yet.

The Good practice of Enterprise Ireland (IR) goes in a similar direction. Programs like Innovation partnership, Technology Gateways and Technology Centres aim at propelling research-industry collaboration mainly via financial incentives, too. However, they still only list the offers. Thus, there is no possibility for platform matching yet.

Action

We recommend developing one website, e.g. called Innovation Link Portal, providing matching of search and offers. The Innovation Link portal aims at creating linkages between regional innovators (in the first step), industry and public and private research institutions via the three platforms:

- A2.1 Eventfinder targeting the lack clarity on information meeting and workshops
- A2.2 Expertfinder targeting the lack of information on competencies for collaboration
- A2.3 Equipmentfinder targeting the lack of information on usable facilities and equipment.²²

- Develop the A2.1 Eventfinder matching platform consisting of search and offers for information events, workshops and further education. The offers section mainly addresses (semi)-public organizers of information events, e.g. Chamber of industry and commerce, Chamber of handicrafts, Wirtschaftsförderung Sachsen (WFS) or cluster associations. The search section mainly addresses companies to express their demands. This, in turn, helps the organizers to develop demand-tailored information meetings.
- Develop an inter-departmental collaboration partnership supporting the optimization of government spending on information meetings and workshops. This will reduce any unnecessary duplication of events and, thus, resources.
- Develop the A2.2 Expertfinder matching platform consisting of search and offers for competencies. The offers section mainly addresses companies and research institutions offering technologies, services and know-how. The search section mainly addresses companies and entrepreneurs seeking for solutions to their challenges. This platform not only enables matching but also indicates both practical challenges and research and development topics. So, potentials for knowledge and technology transfer, e.g. in terms of contract research or research-industry collaboration, becomes visible. By doing so, even potentials for clustering and cross-clustering might become visible. Consequently, technology transfer manager could pro-actively approach potential collaborators offering facilitating their matching. Possible events or methods could be public or private on-site visits and problem-solving conferences.
- Develop the A2.3 Equipmentfinder matching platform consisting of search and offers for facilities and equipment. The offers section mainly addresses companies and research institutions offering their (core) facilities and equipment pool for on-site usage or lent. This will help to reduce the margin of unused resources, e.g. dead space or machines' idle capacities. As it is the case for the Expertfinder platform, the Equipmentfinder platform could be the basis for research-industry collaboration, too. However, there are only few equipment pools created and even fewer are publicly accessible, so far.

²¹ Thüringer Ministerium für Wirtschaft, Wissenschaft und Digitale Gesellschaft (2018, p. 52).

²² For an outside-RATIO reference please see, e.g. Bundesministerium für Wirtschaft und Energie (2017, p. 18) or [South Africa's Tehnology Showcase and Matchmaking Portal](#).

There is no Good practice in Saxony.²³ Hence, especially the universities (of applied sciences) should be encouraged to create and publish their equipment pool.

- Advertise the Innovation Link Portal with a company-targeted marketing campaign in Saxony using different channels, e.g. internet, radio and trade fairs.²⁴

Outlook

Once the Innovation Link Portal is frequently used, a further improvement could be the arrangement of the payments and contract agreements by the portal, e.g. it is the case for AirBnB for instance.

If the Saxon Innovation Link Portal becomes a Good practice, upscale it to a German Innovation Link Portal.

Players involved

Innovation Link Portal

- **Institution administering the Innovation Link Portal and matching platforms**, e.g. State Chancellery of Saxony
- **External marketing agency** running the marketing campaign

A2.1 Eventfinder

- **Search:** Industry, esp. companies and entrepreneurs as well as science esp. universities (of applied sciences)
- **Offers: Information meeting and workshop offering institutions:** Chamber of industry and commerce, Chamber of handicrafts, Wirtschaftsförderung Sachsen (WFS), futureSAX, Technology transfer offices, e.g. Saxony⁵, Cluster associations, e.g. NEU e.V. and entrepreneurs' associations, e.g. Bundesverband mittelständische Wirtschaft, Unternehmerverband Deutschlands e.V.

A2.2 Expertfinder

- **Search and Offers:** Industry, esp. companies and entrepreneurs as well as science, esp. universities (of applied sciences) and research institutes

A2.3 Equipmentfinder

- **Search and Offers:** Industry, esp. companies and entrepreneurs as well as science, esp. universities (of applied sciences) and research institutes

²³ For an outside-Saxony Good practice see, e.g. [FSU Jena](#) or [CAU Kiel](#).

²⁴ For an outside-RATIO reference please see: Thüringer Ministerium für Wirtschaft, Wissenschaft und Digitale Gesellschaft (2018, A20).

Timeframe and costs

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Inter-departmental collaboration partnership	-	-
2019/01- 2019/06	Develop website with its three matching platforms 2.1., 2.2. and 2.3. Application programming interface for the authorities providing the information on the several funding programs	(EUR 50,000)	t.b.a.
2019/07- 2019/08	Internal testing phase within selected institutions	-	-
2019/09- 2019/10	Innovation Link Portal's launch Marketing campaign	EUR 30,000	- t.b.a.
2019/12- 2020/03	Internal evaluation phase	(EUR 20,000)	t.b.a.
Sum		EUR 100,000	t.b.a.

Action 3: E-Commerce micro grant

Introduction

In the latest Saxon innovation strategy (2013), the role of E-Commerce in people's life was identified already. In Germany, ordering goods or services online is one of the most used internet services. 64% of the Germans purchased goods or services²⁵. So, E-Commerce's importance for people is acknowledged on policy level. However, there are no specific programs supporting companies going online with a website or a simple webshop. This is surprising since the Federal Ministry for Economic Affairs and Energy underlined both the opportunities of online presence for companies and its costs. Both websites and webshops make companies visible to the world market. Moreover, they can be the source of additional revenues. Thus, they can become of eminent importance for companies facing less consumers, which is the case for many rural areas. Nonetheless, online presence requires resources and skills.²⁶ Going online makes consumers only one click away but concurrent opens competition world wide. Hence, companies not only compete with their products or services but also with their online presence. One approach to increase coverage online and, in most cases, professional appearance is rather joining established platforms than optimizing its own online presence.

Background

Innovation vouchers are that policy instrument almost all RATIO project partners' regions or countries have in common. Usually, these vouchers are earmarked for companies to develop an innovative solution via research-industry collaboration. However, only a few offer micro-grants characterized by small amounts

²⁵ Staatsministeriums für Wirtschaft, Arbeit und Verkehr (2013, p. 73).

²⁶ Bundesministerium für Wirtschaft und Energie (2017, p. 18).

of money, usually less than EUR 10,000, and very little bureaucratic burdens. For instance, the Czech partner presented in RATIO's phase 1 a recommendation of a micro-grant earmarked for companies to develop their online presence. We highly appreciate this recommendation because we are convinced that this instrument can be a kind of activation energy for the companies' internationalization. The latter, in turn, is considered as one promising opportunity to generate further sources of revenues, especially in rural areas. In Saxony, there are micro-loans, e.g. DMK Dresdner Mikrokredit AG, but no micro-grant, so far.

Action

- Establish a micro-grant earmarked for companies to develop an online presence. This can be just a website but webshops and especially platforms should be preferred, even monetarily. All business activities should be welcome, but E-Commerce should be favoured, even monetarily, because in this case direct revenues and internationalization are more likely. Companies from all regions should be eligible but companies from rural areas should be favoured, even monetarily because going online is especially for rural companies an opportunity to generate additional revenues and, thus, compensate for declining numbers of local clients.
- Only micro companies should be eligible because the activation energy in terms of grant is most important for them. Moreover, there are several digitalization loans for larger companies, too.
- The micro-grant should cover up to 50% of the earmarked expenditure but maximum EUR 2,500. Applications should be accepted through the whole year to create a quickly available funding instrument.

Players involved

- **Authority issuing the micro-grant:** Saxon State Ministry for Economic Affairs, Labour and Transport.
- **Authority administering the micro-grant:** Sächsische Aufbaubank (SAB) or futureSAX.

Timeframe and Costs

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Economic analysis of the micro-grant's impact on the micro company's sales and revenue	(EUR 5,000)	t.b.a.
2019/04- 2019/06	Decision making process on the micro-grant's introduction Application programming interface for the authorities providing the information on the several funding programs	-	-
2019/07- 2020/03	Internal evaluation phase	-	-
Sum		(EUR 5,000)	t.b.a.

INNOVATION AND TECHNOLOGY TRANSFER FROM HIGHER EDUCATION

Analysis and Background

The Saxon innovation system has been examined in a large number of studies. Below you find the summarized central characteristics.

In Saxony there are few major companies compared to the West German corporate structure. The resident large enterprises (this applies often to the medium-sized enterprises also) find themselves in a position rather at the end of the value chain (keyword: extended workbench). Both are relevant to the innovation system in that large companies are often "takers" of university results. In addition, large companies carry out their own research and development activities and stimulate small and medium-sized businesses to do the same in their area.²⁷

In comparison, Saxon companies have significantly lower R&D spending than companies in West Germany. This results from the lower resources of the larger part of SME in Saxony.²⁸ Nonetheless, a positive trend can be observed. While the share of R&D expenditures in Saxony's GDP increased by 12% between 2005 and 2014, the number of operating companies increased slightly from 1,094 in 2012 to 1,123 in 2014, accounting for 0.4% in both years corresponds to all companies in Saxony.²⁹ The expenditure increased in this time from 597 euro per employed person to 688 euro per employed person.³⁰ Here the entire chamber district Dresden stands out: in all considered years the expenditure for research and development per worker is twice as high as in the chamber districts Leipzig and Chemnitz. The share of employees in research and development in Saxony in the years 2013 and 2015 was 7.2 and 8.0 per 1,000 employees subject to social security contributions. This shows a slow approach to the nationwide share of 13.1.

In 2017, Saxony received a total of 719 patent applications from the German Patent and Trademark Office (DPMA), which corresponds to 18 applications per 100,000 inhabitants. Thus, the number of patent applications at the DPMA decreased slightly compared to previous years, in 2016 there were 810 (20 / 100,000 inhabitants) patent applications from Saxony. In Germany as a whole, there was a slight decline within the years from 59 to 58 patent applications per 100,000 inhabitants at the DPMA.³¹ With regard to the patent applications at the European Patent Office (EPO), the city of Dresden stands out again: in 2011³² there are 311 patent applications per million inhabitants, followed by Chemnitz with 126 and the district of Mittelsachsen with 119 patent applications per million inhabitants. In 2012, this trend will almost continue: Dresden is ahead with 219 patent applications per million inhabitants, followed by the district of Central Saxony with 112 patent applications per million inhabitants.

In addition to or in conjunction with the size differences, differences can also be identified in the industry structure. Compared with the new federal states, which still have fewer companies from sectors with higher-quality technologies, Saxony has recorded steady growth in this sector (from 18.38% to 21.3% in

²⁷ Astor, Michael / Berewinkel, Jan / Klose, Georg / Schindler, Eva (2010) S. 1 ff.

²⁸ Hausberg, Bernhard / Reuß, Karsten / Stahl-Rolf, Silke (2015) S. 29f.

²⁹ Vgl. Standortbericht Sachsen 2016.

³⁰ Werte für einen Vergleich mit Deutschland liegen für die Anzahl betreibender Unternehmen und für den Aufwand nicht vor.

³¹ Vgl. Deutsches Patent- und Markenamt: <https://www.dpma.de/dpma/veroeffentlichungen/statistiken/patente/index.html>; zuletzt geprüft am 19.09.2018.

³² Kleineräumig sind keine aktuelleren Daten verfügbar.

the period from 2010 to 2016).³³ This positive development is also reflected in the patent applications, especially in the field of high technologies, so that here Saxony now occupies the seventh place in the nationwide comparison. In the Saxon economy, a lower propensity to export (37.6%) can be observed than in the West German states (49.1%). Nevertheless, the Free State is above the average of the new Länder, including Berlin (35.4%), and is experiencing steadily growing exports.³⁴ The relatively lower level of export activity is explained by the fact that the majority of companies are still focusing on regional sales markets.

The disadvantages in the regional innovation system due to its size and sector structure are at least partially compensated by strong players from science and research. This applies both to the universities and in particular to a high density of non-university research institutions. Considerable innovation successes from the transfer of knowledge and technology between science and SMEs in Saxony can be seen in this context. However, it is also true that the strong output in science and research is still countered by too few and resource-poor innovation players. This ultimately leads to a commercialization of the research results mostly outside Saxony.³⁵

RESEARCH AND DEVELOPMENT IN COMPANIES

For East Germany as a whole and also for Saxony it can be said that the productivity gap compared to the West results from structural differences in the entirety of East German industry, not from the technical-economic backwardness of the individual companies or even the lack of motivation or qualification of their employees. With the same size and product range, medium-sized industrial companies in the East are at least competitive with their competitors in the West, and even superior in new investments.³⁶

The focal points of the Saxon economy lie in the sectors:

- Engineering
- mobility, automobile
- microelectronics
- environment
- Renewable energies
- Life Science, Health Economics, Medicine
- Red and white biotechnology
- Nanotechnology
- logistics

In general, a trend towards a stronger differentiation of the sector structure for Saxony can be observed. The strength of the Saxon economy is seen to be that the diversity of cross-industry companies is leading in East Germany. Especially in the field of high technologies, Saxony is “one of the few regions worldwide that has all six key technologies defined by the European Commission. These, as one of the most important sources of innovation in the digital industrial age, are indispensable technological building blocks for a wide range of product applications. Together with the six universities, 19 universities of applied sciences and the 32 institutions of Leibniz Association, Fraunhofer, Max Planck Society and

³³ Vgl. Technologiebericht Sachsen 2018.

³⁴ Astor, Michael / Berewinkel, Jan / Klose, Georg / Schindler, Eva (2010) S 1 ff.

³⁵ Astor, Michael / Berewinkel, Jan / Klose, Georg / Schindler, Eva (2010) S. 22; und Kedzierski, Ute (2014) S. 9ff.

³⁶ Braun, Gerald / Gura, Tobias / Henn, Sebastian / Lang, Thilo / Schürmann, Carsten / Voß, Karsten / Warszycki, Pawel / (2013) S. 27ff.

Helmholtz Association research and develop numerous cluster cooperations on new processes and technologies in the fields of microelectronics, nanotechnology, photonics, biotechnology, new Materials and engineering.”³⁷

With regard to the sectoral focus, regional peculiarities can be observed in the regions of Leipzig, Dresden and Chemnitz.³⁸

Leipzig	Dresden	Chemnitz
▫ building industry	▫ materials	▫ motor vehicle
▫ medicine	▫ medicine	▫ electronics
▫ Solarvalley Central Germany	▫ biotechnology	▫ environmental-technologies
▫ BioEconomy Cluster	▫ microelectronics	▫ mechanical engineering
▫ environmental technologies	▫ measuring and control technology	▫ textile
	▫ mechanical engineering	▫ building industry
	▫ solar technology	
	▫ cool Silicon	

To promote the transfer a large number of technology agents and transfer projects have become established in Saxony. For these it can be stated that in the majority of cooperation and transfer projects in Saxony no intermediaries were used. The companies obviously prefer direct contact. Research results show that companies are not planning to intensify the involvement of intermediaries in the future. Therefore, intermediaries have the task of attracting actors without transfer experience for technology transfer. The transfer partners complain that the intermediaries do not at least partially offer the services they need and that the intermediary landscape is very fragmented.³⁹

The innovative activity in the craft sector and the importance of innovation in the craft sector can only be limited by means of classic R&D figures. According to R&D survey by the Stifterverband in 2014, companies with fewer than 500 employees only account for 14% of total R&D expenditure. In the case of R&D personnel, although the share increases to 23.4%, the figures show that R&D-based innovation activities in Germany are largely supported by large companies. Probably the part of the handcraft is still clearly under these data due to the small company structures.

However, this should not be confused with a low innovation activity in the craft sector. Especially as the available key figures reflect the input side of the innovation processes. A look at the output side relativizes the results.

³⁷ Artikel: Sachsen: Ein unterschätzter Wirtschaftsstandort - Hochtechnologie mit Tradition.

³⁸ Braun, Gerald / Gura, Tobias / Henn, Sebastian / Lang, Thilo / Schürmann, Carsten / Voß, Karsten / Warszycki, Pawel / (2013) S. 65, S. 80ff, S. 187ff.

³⁹ biosaxony e.V. (2014) S.1 ff and Kedzierski, Ute (2014) S. 27.

	Enterprises with product innovations	Enterprises with process innovations	Product innovators with continuous R&D	Process innovator with continuous R&D
SME handcraft sector	31,1 %	23 %	17,4 %	18,1 %
Non-handcraft SME	39,2 %	29,3 %	27,7 %	26,0 %

The handcraft sector includes companies that initiate their own innovation projects in order to generate fundamental innovations, as shown in the figures above. However, the application-oriented, practical experiential knowledge of the craft companies should be emphasized. It empowers them to act as problem solvers and to find solutions to specific questions for their customers. In particular, the accumulated treasure of practical experience, that is bound to persons, can be a source of difficult to imitate competitive advantages.

A closer look at the types of innovation shows that it is seemingly harder for the craft sector to realize product innovations from their own R&D activities. In the other innovation fields of processes, marketing, organization, the research-based craft companies succeed as well as their medium-sized, research-based counterpart outside the craft.

Precisely because the crafts are primarily active in local and regionally narrow markets, it occupies an important position in the innovation system in this area. Due to the functional spatial division of labor, such regions are disadvantaged insofar as the stock of research-intensive industries is generally quite low. And if such a company is still represented locally, then often only in the form of outsourced operational functions with low innovation relevance (such as production and assembly). In contrast, the situation in the craft sector is different. Because the majority of small and medium-sized enterprises are still organized on a company-by-business basis, their innovation potential is fully exploited in the problem regions. In rural-peripheral, structurally weaker areas, this reduces the negative consequences of the functional spatial division of labor.

KNOWLEDGE AND TECHNOLOGY TRANSFER AT UNIVERSITIES

The role of universities in innovation and transfer is often analyzed in the dimensions of third-party funding and start-up activities. Saxon universities are more than successful in acquiring third-party funds. Third-party funding per university professor in Saxony is not only the highest in Germany, but also the highest among university professors in recent years. The third-party funds of professors of universities of applied science are lower than those of university professors. Reasons for this are amongst others the subject structure and the stronger focus on teaching in universities of applied sciences. In terms of third-party funding per professor of a university of applied science, Saxony's national average of 39,840 euros per year in 2015 is well above the average of the old Länder of 35,360 euros and slightly lower than that of the new Länder of 41,580 euros. The ratio of external funding from industry to R&D expenditure at universities gives an insight into the application and networking of universities with industrial economy. With a ratio of 10.4, Saxony 2012 is above both the value in the old Länder of 9.6 and the value in the new Länder of 8.6. This dimension is typically a domain of technical universities and universities of applied science and research.⁴⁰

⁴⁰ Hausberg, Bernhard / Reuß, Karsten / Stahl-Rolf, Silke (2015), S. 31f.

While there are no studies on individual universities for third-party funds, there is a comparative study of the start-up activities with individual results for the applicant universities.⁴¹

The subsequent table shows the results.

	Leipzig university Comparison university	TU Dresden large	HTW Dresden Comparison	HS Mittweida medium-sized	HTWK Leipzig university	TU Chemnitz	Westsächsische Hochschule Zwickau Comparison university	HS Zittau small
anchoring start-ups	-	○	○	○	-	+	○	+
sensitization for start-ups	+	○	○	○	○	+	+	○
support for start- ups	○	○	+	+	○	+	+	○
activities for start-ups	+	○	+	○	○	+	+	○

Legend: + = positioning in the midst of the 25 % best universities in the comparison group,
○ = positioning in the middle 50 % of the universities in the comparison group,
- = positioning in the 25 % of the worst universities in the comparison group.

The evaluation of the TU Chemnitz and the Westsächsische Hochschule deserve special and positive mention within their comparison groups. The results also suggest that there is potential for exchanging experiences in the field of start-up support between the universities.

In general, all German universities are credited with a good start-up climate thanks to the dedication of consultants and professors, satisfaction of the founders with the advice and support offered by the universities, and the search for partners and investors.

For the segment of high-tech start-ups from Saxony, Saxony is just above the German average. The share of high-tech start-ups in all start-ups in the period 2012-2016 is 7.7%. However, the number of start-ups between 2007 and 2014 has declined more sharply than in the old and new federal states, so that by comparison Saxony's position is deteriorating. The service sector, including high-tech services, software and knowledge-intensive services, has a lower start-up intensity than in the old states, but higher than in the new states.⁴²

The role of higher education institutions in the local transfer system can be summarized in a SWOT analysis based on the experience gained in the project.

⁴¹ Grave, Barbara / Hetze, Pascal / Kanig, Annett (2014): Gründungsradar 2013.

⁴² Hausberg, Bernhard / Reuß, Karsten / Stahl-Rolf, Silke (2015), S. 31.

At the level of the **strengths**, the universities show:

- A **traditionally good networking between the regional economy and universities of applied sciences** due to its application orientation. This shows itself through the implementation of studies with compulsory internships and final theses in cooperation with companies.
- This results in a large number of **positive transfer experiences** of the universities with the partners from the economy.
- The topics dealt with by the universities show a high relevance for the respective regions and a considerable transfer potential.
- In this context, a **good infrastructure and resources of the universities in their core areas** should also be seen as strengths.

Weaknesses for the universities lie in:

- A **lack of non-professorial teaching staff of the universities of applied sciences** and thus a lower staffing than at universities, which is reflected in the opportunities for the development, promotion and implementation of transfer projects.
- Furthermore, it should be noted that **transfer strategies exist, but their implementation in structures and offers of the universities still needs time.**
- This corresponds to the fact that the processes within the universities are perceived by these as well as by the partners from business and intermediaries rather **bureaucratic and inflexible** and thus hinders transfer.
- Ultimately, this anchoring of the subject of transfer could be the basis of the fact that universities consistently see a weakness in the **self-communication of their transfer potential.** This is confirmed or mirrored by the economy with the reference to the distance of science to practice and thus the ability to address previously unattained companies.

Opportunities for promoting the transfer can be seen in the following aspects:

- **Innovation pressure of enterprises:** The topic of innovation, and thus also knowledge and technology transfer, seems to gain increasing importance in the social and economic discussion.
- The **positive economic development** in Saxony opens up new scope for companies in terms of innovation activities as well as the retention of graduates and specialists.
- The topic of **lifelong learning** could be an opportunity, especially for universities of applied science with their traditionally more application-oriented profile, to develop contacts with companies through up-to-date offers.
- For regions with proximity to other countries, **cross-border activities** could provide opportunities to internationalize transfer activities, particularly at the level of clusters, e.g. as part of joint projects with the EU.

Threats and challenges arise from:

- A **small-scale economic structure**. Despite the lack of large companies and the associated lack of R&D departments, buyers of transfer potential in SMEs must be found to enable a regionally oriented transfer. In comparison to the old federal states, this has smaller (financial) resources for innovation due to its smaller size and a different position in the value chain.
- A great importance, if not **dependency, on funding** for both universities and companies. The existing scarcity of resources in the Saxon innovation system is also compensated by subsidies. In addition to the possibilities offered by this strategy, however, there is also a dependency on these resources and a significant risk if state resources are reduced (for example due to new regulations in the Solidarity Pact).
- the **demographic development**. Here are the challenges in an aging workforce of companies and universities. Especially for the universities outside the major centers, the problem is exacerbated by the emigration tendencies of the graduates.
- the **regional (edge) situation of some of the universities**. In addition to the challenge of attracting new talent to the region, there is the difficulty that the local innovation system can only be developed through start-ups and transfer. The generation of larger industrial settlements (in the sense of lighthouses) is much more difficult than in the big cities.

Recommended Actions

It is the aim of the Free State Saxony “to belong to the scientifically and economically leading Regions of Europe in the year 2020.”⁴³ Action fields, that contribute to the realization of this aim, are:

- support of internationalization in the system of innovation
- strengthening of the innovative capability of the medium-sized enterprises
- strengthening of the transfer of technology out of the institutions of higher education
- development of specific measures for the support of innovations in rural areas
- a cross-sectional topic is the advancement of the funding landscape for innovation in Saxony

INTERNATIONALIZATION OF THE INNOVATION SYSTEM

The internationalization of the innovation system is the aim as well as the recommendation for action to improve the competitive position. Within the quarrel with the requirements of the international economy the enterprises are challenged to face those requirements and improve their competitiveness by doing this.

For this purpose, there is a set of measures, that include an increase of the presence of international actors in Saxony as well as the presence of Saxon actors on the international markets. In detail, those are:

Further increase of the **attractiveness of the high-tech location Saxony** for national and international investors. Considerable success has already been achieved here in the past but is not at the desired level of international competitiveness. The activities must be continued and developed further. This includes, for

⁴³ Vgl. Staatsministerium für Wirtschaft, Arbeit und Verkehr: <http://www.technologie.sachsen.de/10776.html>, zuletzt geprüft am 19.09.2018.

example, the use of the location advantage of a research-oriented, technology-oriented science by stimulating the development of further industrial fields of application at the interfaces to the main scientific areas. Or to set impulses for the development of new industrial fields of application (fields of specialization) in the overlapping of sectors and technology fields.

Support of the **internationalization of clusters and networks** in Saxony. Clusters and networks are often developed with support (financially but also in the form of advice) from the state and municipalities. As part of this support, the topic of internationalization can be placed by influencing the strategies and goals of the clusters and by providing additional financial resources for international activities. These can be of different nature such as participation in fairs and congresses, international certification of clusters, development of partnerships with international initiatives, use of travel of politics or international business trips organized on behalf of the Federal Office of Economics and Export Control (BAFA) or other institutions.

At the level of companies, the topic of **internationalization** can be stimulated **in the entrepreneurial innovation process**. This could, for example, be achieved through a higher funding quota in innovation projects with international partners or through a targeted promotion of the participation of Saxon actors in the European Partnerships for Innovation. Also, from a further strengthening of the Enterprise Europe Network Saxony (EEN) we have to expect that there will be impulses for the internationalization in the innovation process. Here it is necessary to improve the awareness of the existing offers. In this context, it seems essential that medium-sized companies know that there is a genuine service offering help for the internationalization of their innovation activities. Another approach could be Action 3: E-Commerce micro grant, as recommended previously.

Internationalization of Saxony as a Scientific Location: With regard to the decreasing number of school leavers, attractiveness for students from abroad is an important aspect. Many students in STEM subjects can become a decisive location factor in the medium term. Attractiveness for students includes affordable living space, an attractive cultural offer and good supraregional accessibility. To ensure that studies do not turn into a short-term "training stay", it is important for graduates to find attractive employment opportunities in the Free State and to actively support the transition into employment. However, it is problematic to see resentments or even attacks on strangers in the living environment.

REINFORCE INNOVATION CAPABILITIES IN MEDIUM-SIZED ENTERPRISES

Challenges and obstacles for the Saxon middle class (as shown, there are often significantly smaller SMEs than in West Germany) in their own innovation capability are often missing partnerships to high technology and science, the lack of ability to more radical innovations and bureaucratic requirements in the use of funds. Here one can start with various measures.

Medium-sized companies should be motivated by means of communication, consulting services and possibly also funding opportunities to **systematize and professionalise their own innovation management**. Often, innovation in SMEs is promoted "at random" and the successes and failures of innovation activities are not systematically evaluated. This is accompanied by a lack of knowledge of their own strengths and weaknesses in the management of innovation projects. This, in turn, often leads to greater risk aversion because there is insufficient information and control over typically risky innovation processes. A lean but systematic innovation management appropriate for medium-sized companies helps to manage the risks associated with innovation and increase the success rates. In addition, another approach will be presented with Action 4.1. Company Health Check.

The **participation of SMEs in innovation-oriented networks and clusters** should be strengthened. Especially when the environment of large companies as reference points are missing, networks and clusters gain in importance. If the SMEs play a central role, the initiation of the clusters by politics is necessary. For SMEs, special incentives should be created to participate in these clusters. These can be, for example, in genuine service offerings such as assistance with applying for innovation funding or a guide function or technology scouting among the members.

A further **expansion of the high-tech sector should be designed in such a way that it contributes to the strengthening of the Saxon middle class**. In concrete terms, this can be achieved by stimulating existing production facilities with company headquarters outside of Saxony through funding opportunities for "R&D germ cells", e.g. through co-operation between enterprises, scientific institutions and regional companies. The goal is to attract large companies with headquarters outside Saxony for an R&D commitment in Saxony, which will ultimately be a benefit for SMEs as well.

Strengthening cooperation and technology transfer between technology-focused start-ups and established SMEs. As a result, the potential of start-ups, which often come from the immediate environment of universities and research institutions, can be better utilized. In many cases, start-ups rely on an agile business model, which envisages takeover by an investor or SME in the medium term. Cooperation or, if necessary, acquisition by an SME can give new impetus for growth in the established companies.

TRANSFER OF TECHNOLOGY FROM UNIVERSITIES

The promotion of technology transfer can be structured along an imagined value-added chain of transfer, from the anchoring of a subject in higher education, to raising partners' awareness for a joint transfer, to the implementation of this transfer. The results show that the challenges are not primarily in the implementation of transfer projects (quality) but in the motivation and intensification of the transfers (quantity).

For a better **structural and strategic anchoring of the subject of knowledge and technology transfer in universities**, the following measures can be derived:

First, the implementation of existing **transfer strategies** within higher education institutions seems to be a priority. The universities in the metropolises have been working here for some time, however, even with the university of Applied Sciences (Fachhochschulen), there is still untapped potential due to their closer connection to the companies and their presence in the spaces between the metropolises. Thus, the many existing individual activities must be structured and made transparent. An important role is played by the **implementation of concrete incentives for transfer**. These do not necessarily have to be financial in nature. To discuss the topic of transfer across the university and thus to give attention and importance to developing goals and standards and to give them recognition in the implementation should be an essential first step. Here the organization of an exchange among universities seems promising.

With regard to universities' transfer strategies, suitable structures and processes should be created or defined in the university administration. This also includes specifically defining internal and external services for transfers. Examples are: central contacts, websites of the universities for transfer, simplified standard processes for cooperation between the university and industry. Following the example of the Career Centers, which have meanwhile been established at many universities, it would be necessary to

examine whether the establishment of **Transfer Service Centers** would enable a new quality of service and handling of transfer activities.

In addition to the topic of transfer in terms of research projects or the exploitation by existing companies, the promotion and **support of business start-ups** should be integrated as an element of promoting transfer.

For the structural and strategic anchoring of the transfer in the university, a systematic treatment of the subject of **economic participation of the universities in transfer success of the enterprises** (eg in the sense of a pro-rated profit participation) can serve. Certainly, this is a long-term perspective, but financial participation in successes can generate funds to support transfer in higher education. Here the connection of the universities in the Anglo-American area reveals the potential of a targeted alumni work. Corresponding models and best practice examples have to be developed and discussed with universities.

Awareness-raising measures for the **use of transfer potential** by the regional economy:

If new companies and especially SMEs are to be integrated into transfer processes, **easy access to information and transparency of information** play an important role. The prerequisite for a successful positioning and communication work is a clear profile of the university with regard to topics and competencies (content profile) and also forms of transfer (procedural profile).

Especially the development, respectively **standardization of transfer forms** should have the potential to create new partnerships. Both universities and industry complain about inflexibility, bureaucracy and distance between university and company. A definition and description of even simple transfer formats (eg feasibility studies as a test of transfer potentials, internships and final theses of students, use of university equipment by companies, ...) can help to resolve these problems. It could be made transparent for the economy how the co-operation can be arranged, it could be offered little complex "introductory formats" and the universities can internally prepare the processes for these formats (contracts, internal billing, permits, ...) to take care for a smooth project implementation.

Communication about transfer potentials is subject to at least two challenges. On the one hand, addressees want a simple and transparent provision of information wherever possible in one place, such as a central website. On the other hand, in terms of information efficiency, the addressees only need information relevant to them, but this probably represents only a very small portion of the total amount of information. One solution could lie in a **dual strategy of centralized services and decentralized specialist communication**.

- The **central service** includes contact persons who can act as guides, standardized formats, examples of success and the general application of the subject Transfer to events in the region. The focus here is on **mediation, image building and lobbying** for the topic in general.
- **"Decentralized" specialist communication** involves the formation of subject clusters between the five universities (see common potentials). Transfer potentials are usually in the technical expertise, this means that within the professional community, the company should be better and easier to reach than by a general communication.

Another option for promoting transfer is the **extension of study programs towards transfer-relevant content**. This should lead to an early sensitization of the young professionals and could help to strengthen the transfer of graduates who stay in the region and to develop new cooperations.

However, the impact of these measures also depends on whether graduates are held in the region. For this purpose, an incentive program could be developed by science, industry and politics to show career development perspectives in the region. A contribution of the universities could be an attractive on-the-job training. This could also include **advanced training on-the-job around the subject of innovation**.

A functioning **alumni work** of the universities can make a contribution here, too. As part of the alumni work, networking with the university is likely to succeed in a special way, especially among graduates who have remained on the job. Here, transfer-relevant contents can be integrated and thus a transfer via graduates and former students can be established.

INNOVATION IN RURAL AREAS

A study by the Economics Institute for Small and Medium-Sized Enterprises and crafts at the University of Göttingen on innovation barriers in SMEs from 2016 shows that for medium-sized companies in rural regions and the craft sector, organizational and personnel shortcomings, such as lack of technological know-how or access to it, organizational problems, lack of specialized personnel and lack of relevant market information, are characteristic. In addition, financing problems and the economic risk in terms of the profitability of their own innovation activity are important. Measures that should face this constellation of barriers are:

Develop targeted activities in the regions with partners on the ground. A closer analysis of the activities in rural areas reveals that innovation-oriented topics often take place not in the field but in the metropolises. There is another problem with the perception and acceptance problem. Participating in events in the metropolises usually leads to the establishment of networks in metropolitan areas and not in rural areas. Activities such as events or building networks in the regions must be tackled here. A disadvantage of the rural regions compared to the metropolises is the lack of critical mass for corresponding activities. Therefore, in a first step the identification of suitable topics with local actors is necessary. Subsequently, targeted activities must be developed around these topics.

The development of **regional competence centers for innovation**, which support SMEs and craft enterprises with knowledge and advice on innovation management and cross-sector networking. In the ideal case, these can act as a "free" innovation management service point in the region.

Medium-sized companies without R&D rely on incremental innovations. Here, the expertise of the employees and thus education and training, plays a decisive role. If the innovative strength of non-researching SMEs is to be strengthened, **the promotion of training skills and the availability of qualified specialists** are important topics. To this end, the cooperation between regional medium-sized industry, the craft industry and vocational schools for the development of innovation in education must be intensified.

For non-researching medium-sized companies, **cooperation with partners from business and science** is a suitable alternative strategy for developing new knowledge for the development of products and services. Here the **regionally located universities** (above all former universities for applied sciences) are of central importance. The promotion of technology transfer and the establishment of clusters and

networks with appropriate visibility around the regional universities is an essential component of promoting innovation in rural areas.

FUNDING LANDSCAPE

In the previous sections, the topic of funding has often been addressed. Saxony pursues an approach that is characterized by the fact that funding should be done breadthwise. This includes innovation projects that are not just geared towards radical innovation or expansion of the technological frontier. In addition to the state funding, the BMWi funding program Zentrales Innovationsprogramm Mittelstand (ZIM) plays a special role.

This development path contributes significantly to a high level of R&D participation of SMEs and a high proportion of turnover through product innovations of R&D-active companies in Saxony and strengthens their competitiveness. Based on this strategy, the following measures can be implemented:

Funding instruments should be more geared to growth, internationalization and cooperation with other actors in the innovation system.

The transparency of the innovation-relevant advisory services of public institutions should also be improved. The topic of innovation is anchored in Saxony in many institutions - chambers, associations, SAB, WFS, technology transfer offices. The economy needs competent contact points, in which all questions related to the topic of innovation are competently answered. This can be achieved through a digital merger of the funding offers (database, website), as recommended in Action 1: Make FÖMISAX transparent. Moreover, existing knowledge and technology structures should be combined to one-stop agencies (advice and web presence with forms, guides and checklists). The agencies should offer competent and complex support services for selected and general questions of the innovation process. These activities could be enhanced by Action 2: Innovation Link Portal.

Bureaucracy reduction is one of the most important demands by the companies. In the field of funding and support, it should be noted that the relevant measures for innovation do not lose their efficiency due to high bureaucracy. One instrument for identifying potential for improvement could be the organization of a **dialogue between the political or administrative authorities and the companies** (in particular those companies whose applications were rejected for formal reasons and those who had not applied for bureaucratic reasons). As part of this dialogue, companies' needs for innovation support can also be queried and discussed.

Further Actions

An example is the initiative Invest Region Leipzig. In this initiative the City and the neighbouring rural districts together bring to market the investment location Leipzig internationally with its Clusters through fair visits and trips abroad.

Another example is the participation of the Cluster Energy and environmental technology of the Region Leipzig (NEU e.V.) within the international exchange of experience in the context of a process of certification of the Clustermanagement (European certified ESCA Label for Cluster Management Excellence). The link between Clusters should also function as a platform to be useful to the enterprises of the clusters to make the entry into the other markets easier.

In order to support the internationalization of medium-sized companies, Sachsen offers a federal program via the SAB for participation in foreign trade fairs and international trade fairs in Germany. In addition, feasibility studies and studies on the attractiveness of foreign markets are promoted.

In order to promote the professionalisation as well as the networking of innovation management in SMEs, the Free State offers through the SAB-transfer assistants (employment of persons with relevant professional experience in science or business with the task of SMEs in the planned transfer of technological knowledge for the realization of product or process innovations to support).

In order to strengthen the innovative capacity of SMEs, the Free State has launched two concrete programs: InnoExpert (the employment of external experts in the company to handle innovative research) and InnoTeam (encourages cooperation between companies and universities or research organizations with the aim of developing new products or technological processes).

To strengthen innovation activities in medium-sized companies, the innovation bonus set up by the Free State of Saxony can be promoted and implemented more strongly.

Concretely, Saxon companies can be supported to use the funding offered by the BMBF for innovation forums. This even makes it possible for companies to develop their own innovation-related networks with their cooperation partners from research and development.

Under the title Saxony high five, five Saxon Universities of Applied Sciences (HAW), namely HTW Dresden, HTWK Leipzig, HS Mittweida, HS Zittau / Görlitz and Westsächsische HS Zwickau, want to implement their jointly developed transfer strategy Saxony5 in the project "Smart University Grid Saxony5". The primary aim of the planned project is to contribute effectively to the innovation between universities, their partners and the target groups in business and society in order to realize the Dynamic Stimulation Cycle described in the Transfer Strategy. The 5-point strategy to be implemented aims at synergies and clout in the transfer network, increasing the reach and visibility of the transfer activities, better penetration of the economy and society, the consistent need orientation of the transfer processes and a new, comprehensive transfer culture at the HAW.

An example of this are the technology scouts established by the City of Leipzig and the IHK Leipzig in cooperation with the agil Leipzig. Their task is to identify innovation potential and needs in companies and to establish contact between companies and universities or research institutions.

One example is the initiative of the Kreishandwerkschaft Meissen, which is developing a network between craft and creative industries for the promotion of innovation in the Elbe region of Meissen as part of the BMBF tender WIR (Change through Innovation in the Region; <https://www.khs-meissen.de/index.php?menuid=63>).

With FÖMISAX, the Free State of Saxony has provided a subsidy database that can be accessed on the Internet with a convenient search function. (<https://www.foerderung.sachsen.de/>). It has to be checked, whether an integration in the federal funding (database <http://www.foerderdatenbank.de/>) is possible.

SKILLS SHORTAGE IN STEM SUBJECTS

Analysis and Background

So far, the targeted policy program was the Saxon innovation strategy 2020. For this chapter, we switch to the Skilled employee strategy Saxony 2020. As mentioned earlier, this strategy has an interface with the Saxon innovation strategy. As it is the case for the latter, the Skilled employee strategy does not distinguish between urban and rural areas. Moreover, rural areas are mentioned only twice in the Skilled employee strategy. Again, we recommend developing policy specifically tailored to the demands of the region. “Digitalization” and the related words of “digital”, “transformation” and “Industrie 4.0” do not exist in the Skilled employee strategy, at all.

Importance of STEM for innovation and international competitiveness

For successful innovation activities of companies and economies, a large number of factors with complex interactions is responsible. Such factors include research and development activities and their promotion, legal frameworks for the protection of intellectual property, financing options for typically risky innovation activities and, finally, the availability of innovation-relevant manpower.⁴⁴

Successful innovation policy therefore also requires a successful policy to ensure the continuation of skilled workers, especially in the area of STEM subjects. They are of particular interest for innovation. Greater labor supply of innovation-related skills leads to increased productivity and competitiveness through additional innovation.⁴⁵

It should be noted that Science, technology, engineering and mathematics (STEM) related qualifications also play a major role outside industry or manufacturing industries. 60% of all employed STEM graduates in Germany are employed in service industries. This is due to a high interconnection of the value chains between the different industries via outsourcing and hybridization of industrial products to service and service components. For Germany as a whole, there is a positive correlation between a higher STEM density, a higher research propensity and innovation successes.

The business model of the German economy with a focus on innovation and export needs to a certain extent and as a central requirement to be permanently successful a variety of STEM professionals in various professional fields (e.g. in the distribution of B2B products and services of the German economy, in the controlling of high-tech Companies, in management, in the analysis of market opportunities or in teaching professions for the STEM subjects) and sectors and not just in the obvious and narrow sense as a developer in the industry.

The increasing digitalization of the industry and the more complex and technically demanding value chains are likely to further increase the need for STEM skills in a variety of professions. Thus, securing the

⁴⁴ Vgl. Erdmann, Vera / Koppel, Oliver / Plünnecke, Axel, (2012): Innovationsmonitor 2012, IW-Analysen, Nr. 79, Köln.

⁴⁵ Vgl. Dakhli, Mourad / De Clercq, Dirk (2004): „Human capital, social capital, and innovation: a multi-country study“, in: Entrepreneurship & Regional Development, Vol. 16, No. 2, S. 107–128 und Aghion, Philippe / Howitt, Peter (2006). Appropriate Growth Policy, A Unifying Framework, in: Journal of the European Economic Association, MIT Press, Vol. 4, No. 2–3, S. 269–314.

demand for skilled workers in the field of STEM is a cornerstone for innovation-oriented policy of economy and education.⁴⁶

The situation of skilled workers in STEM professions in Germany and Saxony

Between 2012 and the third quarter of 2017, employment subject to social security increased by 7.8 percent on average across all STEM professions. With an increase of 18.9 percent, the academic STEM professions are by far the largest in terms of growth. On the other hand, there is a comparatively small increase in the specialised STEM professions (+8.9 percent, usually technicians and foremen) and in the specialised STEM professions (+4.5 percent, usually professions with apprenticeship).

For Saxony data is available between June 2013 and June 2017. Accordingly, the total number of STEM employees increased from 36,8419 in 2013 to 38,6119 employees by 4.8%. Within the various qualification levels, the number of academics has increased by 11.5%, that of the specialists by 5.2% and of skilled workers by 3.3%.

The share of older employees (aged 55 and older) in the total number of employees, subject to social security contributions in STEM professions is of particular importance for a number of reasons:

- Since this group of people will retire from the labor market in the foreseeable future due to their age, they must be replaced by new employees in order to at least maintain the number of employees.
- Moreover, this group is one of the baby boomers, which entails a particularly high quantitative replacement requirement, consequently.
- Finally, the quota shows, whether the efforts to ensure the skilled labor are effective and whether better opportunities on the job market of older workers could be achieved.

The data show that the proportion of older employees of all STEM employees in the national average rose from 15.1 to 18.4 percent between the fourth quarter of 2012 and the third quarter of 2017. The situation in Eastern Germany (excluding Berlin) is more serious than in Western Germany. The share of older people in all STEM employees was slightly below the federal average at 17.9%. At 21.5%, more than every fifth employee is already 55 or older, and Saxony has a share of 20%.

In its spring report of STEM, the Institute for Economic Research Cologne has identified supply, demand and bottleneck in STEM professions.⁴⁷ The statistics of the Employment Agency were the starting point. It was considered that by far not all vacancies at the various qualification levels are reported to the National Employment Agency. As part of a representative survey, the IW (Institute for the German Economy, Cologne) has collected the data and by extrapolation gained the demand for skilled workers. The results are summarized below.

In April 2018 all over Germany, there were 486,600 vacant STEM positions. Based on 6.82 million employees subject to social security contributions in STEM professions, this figure is 7.1 percent. According to the National Employment Agency, 386,119 people were employed in STEM professions in Saxony in 2017. The corresponding quota in STEM professions is therefore 7.0%.

⁴⁶ Vgl. Anger, Christina / Koppel, Oliver / Plünnecke, Axel (2018): „STEM-Frühjahrsreport 2018. STEM – Offenheit, Chancen, Innovationen. Institut der deutschen Wirtschaft Köln S. 9f.

⁴⁷ Vgl. Anger, Christina / Koppel, Oliver / Plünnecke, Axel (2018): „STEM-Frühjahrsreport 2018. STEM – Offenheit, Chancen, Innovationen. Institut der deutschen Wirtschaft Köln S. 37ff

TABLE 1: OPEN STEM POSITIONS IN GERMANY BY FEDERAL STATES AND PROFESSIONAL AGGREGATES IN 2018.

	STEM-skilled workers (usually professions with apprenticeship)	STEM-specialists activities (usually foremen and technicians)	STEM-expert activities (usually academics)	STEM- professio ns in total
Baden-Württemberg	38.600	13.900	24.800	77.300
Bayern	43.500	17.100	29.000	89.500
Berlin/Brandenburg	10.600	3.900	7.700	22.200
Hessen	15.600	5.100	9.200	29.900
Niedersachsen-Bremen	27.600	8.000	14.400	50.000
Hamburg/Schlewsig- Holstein/Mecklenburg- Vorpommern	17.700	5.200	9.400	32.200
Nordrhein-Westfalen	55.200	16.100	26.100	97.300
Rheinland- Pfalz/Saarland	16.600	4.400	7.600	28.600
Sachsen	14.300	5.100	7.800	27.200
Sachsen- Anhalt/Thüringen	19.500	5.200	7.700	32.400
Deutschland	259.300	83.800	143.500	486.600

In total, 107,936 people with STEM qualification were looking for work in April 2018. From Saxony 9,960 people were looking for work, this is 9.2% of all jobseekers. If employment in STEM professions is used as a benchmark (5.6% of all STEM employees in Germany work in Saxony), a comparatively high number of jobseekers from the STEM working environment can be seen.

TABLE 2: UNEMPLOYED IN GERMANY THAT ARE REGISTERED BY STEM PROFESSIONAL AGGREGATES AND FEDERAL STATES IN 2018.

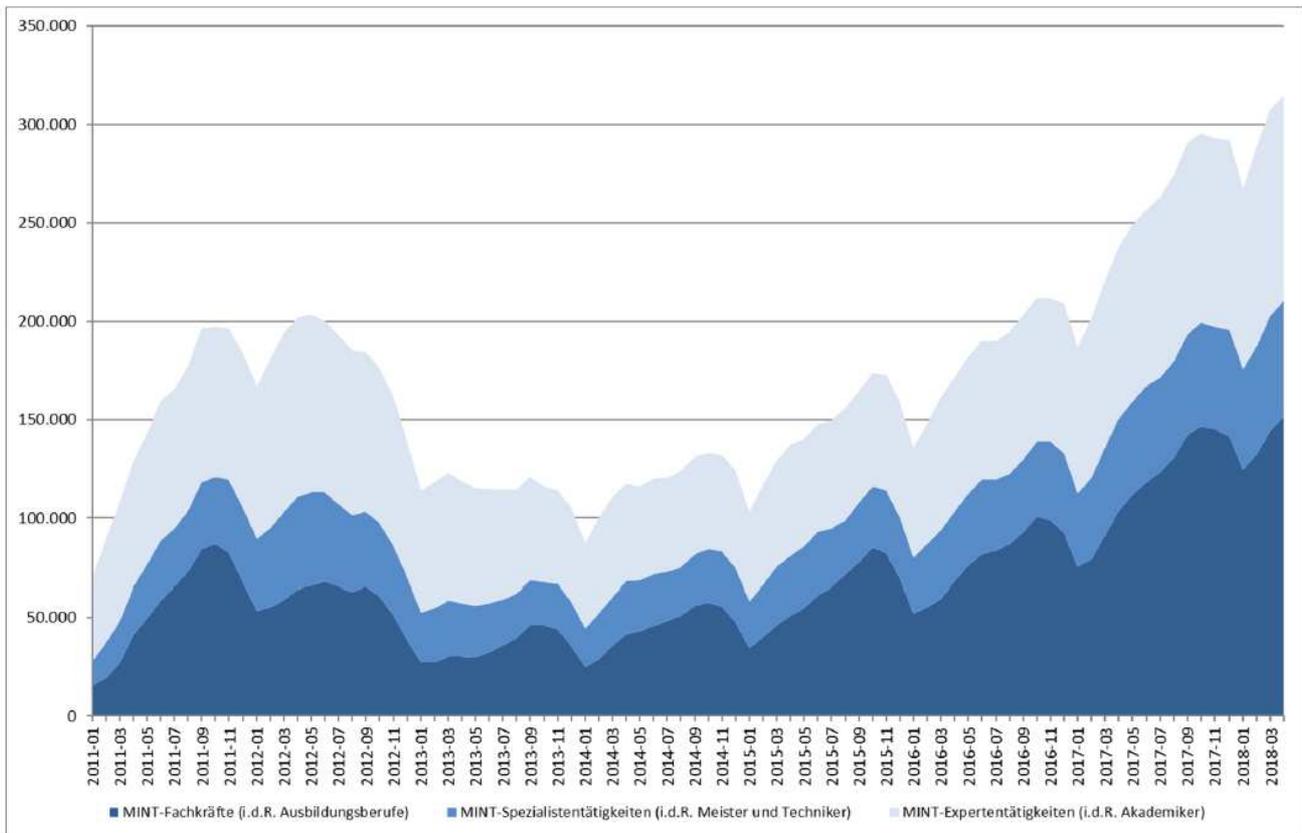
	STEM-skilled workers (usually professions with apprenticeship)	STEM-specialists activities (usually foremen and technicians)	STEM-expert activities (usually academics)	STEM- professio ns in total
Baden-Württemberg	13.770	2.840	4.748	21.358
Bayern	11.617	3.028	5.414	20.059
Berlin/Brandenburg	7.728	2.362	5.320	15.410
Hessen	6.159	1.687	2.907	10.753
Niedersachsen/Bremen	11.366	2.660	4.494	18.520
Hamburg/Schlewsig- Holstein/Mecklenburg- Vorpommern	7.276	2.084	3.683	13.043
Nordrhein-Westfalen	29.903	6.373	8.783	45.059
Rheinland- Pfalz/Saarland	6.124	1.499	2.201	9.824
Sachsen	6.268	1.227	2.465	9.960
Sachsen- Anhalt/Thüringen	7.725	1.277	1.965	10.967
Deutschland	107.936	25.039	41.980	174.955

If one puts the demand of workforce and the supply of workforce in relation to one another, then "bottlenecks" can be determined in the STEM field. The figure indicates how many vacancies there are on 100 applicants. At a value of 100, theoretically all vacancies could be filled by available employees. For Germany as a whole, with a value of 278, there is a clear excess of demand for skilled workers in STEM disciplines, so, there are 278 vacancies for 100 applicants. For Saxony, 273 shows almost the same value as the national average.

TABLE 3: VACANT STEM POSITIONS PER 100 UNEMPLOYED IN GERMANY, BY FEDERAL STATE AND PROFESSIONAL AGGREGATES IN 2018.

	STEM-skilled workers (usually professions with apprenticeship)	STEM-specialists activities (usually foremen and technicians)	STEM-expert activities (usually academics)	STEM- professio ns in total
Baden-Württemberg	280	489	522	362
Bayern	374	565	536	446
Berlin/Brandenburg	137	165	145	144
Hessen	253	302	316	278
Niedersachsen/Bremen	243	301	320	270
Hamburg/Schlewsig- Holstein/Mecklenburg- Vorpommern	243	250	255	247
Nordrhein-Westfalen	185	253	297	216
Rheinland- Pfalz/Saarland	271	294	345	291
Sachsen	228	416	316	273
Sachsen- Anhalt/Thüringen	252	407	392	295
Deutschland	240	335	342	278

The IW has analyzed the temporal development of the STEM workforce gap in the STEM report. Considering the different levels of qualification and ignoring the fact that it is not easy to fill vacancies with applicants from the same level of qualification, this results in the simplified development of the workforce gap below. There is a continuous trend towards an increase in the gap of skilled workers which, despite successes in the development of the number of graduates in STEM programs, could not be slowed down or even reversed.



Development of students in STEM subjects in Germany and Saxony

If one looks at the development of the total number of students and in the STEM subjects (Table 4), the positive development of a greater disproportionate increase in the number of STEM students compared to all students has already been mentioned for Germany and also for Saxony. It obviously succeeds in increasing the attractiveness of the STEM subjects among the students, and accordingly, the STEM share in all students increases. It is striking that the STEM share in Saxony is about 5% above the STEM share at national level.

TABLE 4: DEVELOPMENT OF THE TOTAL NUMBER OF STUDENTS IN STEM SUBJECTS.

		Saxony ⁴⁸	Germany ⁴⁹
Students in total	WS 2010/2011	109.761	2.217.294
	WS 2017/2018	109.336	2.844.978
	change in %	-0,4%	28,3%
STEM-Students	WS 2010/2011	45.737	815.923
	WS 2017/2018	47.959	1.087.760
	change in %	4,9%	33,3%
STEM-share	WS 2010/2011	41,7%	36,8%
	WS 2017/2018	43,9%	38,2%

Importance of migrants for STEM workforce

Although, as shown, the number of students (and therefore also the number of graduates) in STEM subjects has increased, the bottleneck situation in STEM professions has worsened. In the outlook, a further tightening is to be expected as the baby boomers will retire from the labor market in the next ten to fifteen years. Against this backdrop, immigration as an instrument for ensuring skilled labor is becoming increasingly important.

The employment dynamics of foreign STEM workers are well above the employment dynamics of German STEM workers. From the fourth quarter of 2012 to the third quarter of 2017, the number of foreign STEM graduates increased by 60.5% (that of German academics by 16%), the number of foreign STEM specialists increased by 45.9% (German STEM skilled workers + 7.2%), the number of foreign STEM skilled workers could be increased by 34.4% (German STEM skilled workers + 2.1%). This means, that the majority of employment growth of 7.8%, that can be observed across all STEM professions is due to foreign workers. Their above average contribution to ensure skilled workers in the STEM segment ranges from electricians to engineers.

⁴⁸ Statistisches Landesamt des Freistaates Sachsen, Statistischer Bericht B III 1 - j/17 - Studierende an den Hochschulen im Freistaat Sachsen 2017, Statistischer Bericht B III 1 - j/17 - Studierende an den Hochschulen im Freistaat Sachsen 2010

⁴⁹ Destatis Fachserie. 11, Bildung und Kultur. 4, Hochschulen. 1, Studierende an Hochschulen Ausgabe 2010/2011 und Ausgabe 2017/2018.

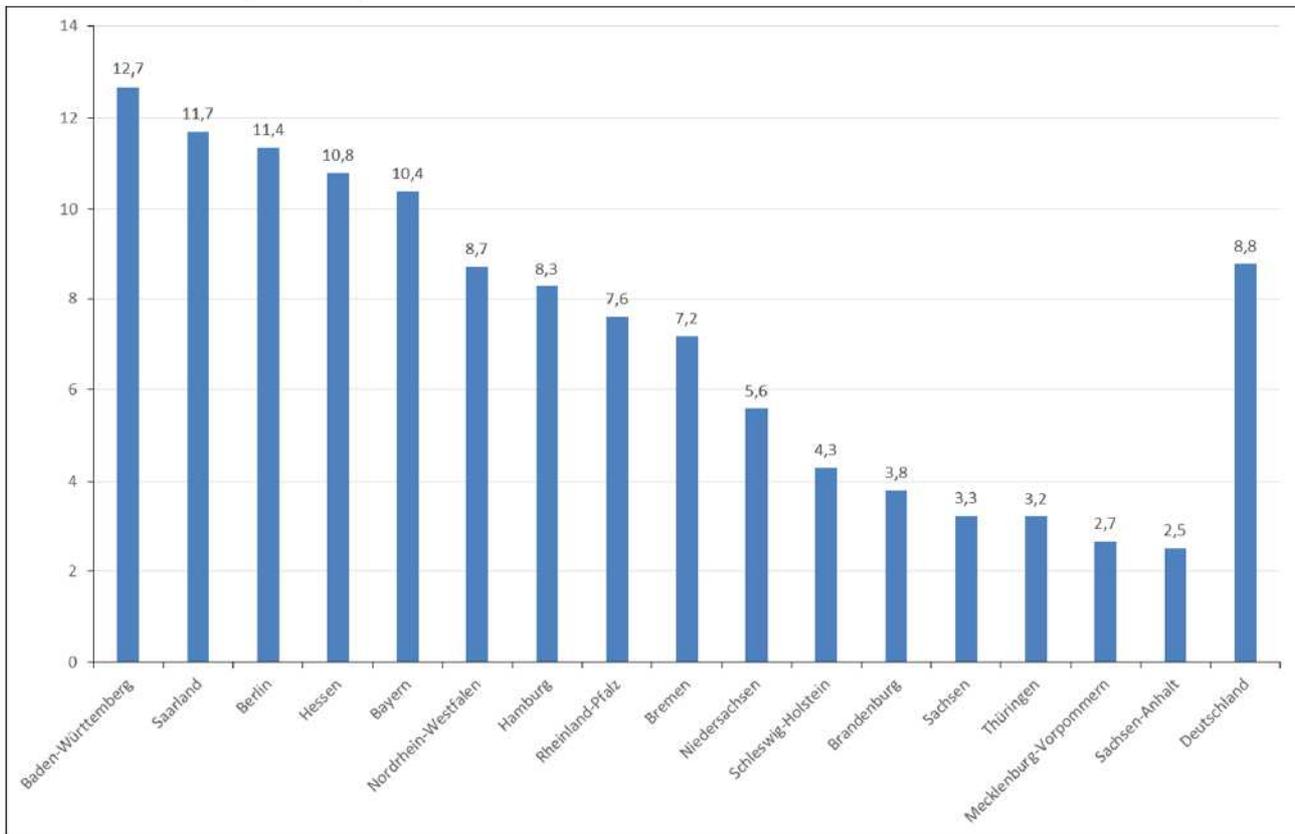


FIGURE 1 PERCENTAGE OF FOREIGN EMPLOYEES OF ALL EMPLOYEES, SUBJECT TO SOCIAL SECURITY CONTRIBUTIONS IN STEM PROFESSIONS, IN PERCENT; REPORTING DATE: 30TH SEPTEMBER 2017. SOURCE: BUNDESAGENTUR FÜR ARBEIT, 2018A; BERECHNUNGEN DES IW.

Calculations by the IW show impressively that statistically there is great potential for ensuring the demand for skilled labor in STEM occupations, by employing migrants in the Eastern German states and therefore also in Saxony. While the proportion of migrants in STEM professions is 8.8% in the national average, Saxony's share is just 3.3%. The figures show that the Eastern German federal states must make greater efforts in the future to activate this potential for skilled workers stronger than before. The task is to develop a sustainable welcome culture in a timely manner and to win significantly more foreign STEM workers than before.⁵⁰

Performance of the Saxon education system in the STEM sector

Saxony is in the INSM (New Social Market Economy) monitor of education 2018 at number one of the 16 federal states and has improved slightly in a five-year comparison. Based on a total of 93 indicators in 12 action areas, the comparative study by the Institute for the German Economy (IW) on behalf of the INSM assesses the extent to which a federal state reduces educational poverty, contributes to securing skilled work and promotes growth.

Particular strengths of the Saxon education system are the support infrastructure (full-time care in kindergardens and elementary schools), school quality (performance of Saxon students in competence

⁵⁰ Vgl. Anger, Christina / Koppel, Oliver / Plünnecke, Axel (2018): „MINT-Frühjahrsreport 2018. MINT – Offenheit, Chancen, Innovationen. Institut der deutschen Wirtschaft Köln S. 43ff

tests), educational advantage (few students, that do not meet the minimum standards) and research orientation (highest third-party funding per professor in Germany). Weaknesses are seen in a comparatively large proportion of prematurely terminated contracts of apprenticeship and an unbalanced age structure of teachers.⁵¹

For 2015, there is a much more favorable teacher student relation in the STEM subjects at the Saxon universities than at the national level. In Saxony, there are 11.1 students for 1 scientific teacher in the field of mathematics and natural sciences (average in Germany, 14.8 students for a teacher). In engineering sciences, there are 22.9 students in Saxony for a scientific teacher and 24.5 students nationwide.⁵²

Significant weaknesses, however, the Saxon education system shows in the field of digitization. As part of the above-mentioned education monitoring, there is a significant need for improvement in terms of IT equipment in schools, the communication media-related skills of teachers and the use of digital media in teaching and a significantly below-average number of students and apprentices in the field of information in Universities and apprenticeship. Some numbers illustrate this problem

- For example, in 2016 Saxony has a quota of 51.9 trained computer scientists per 100,000 employees. The German national average is 73.1, leaders are Bremen (104.9) and Baden-Württemberg (97.2)
- A similar picture emerges among IT academics: there are 58 IT graduates in Saxony for 10,000 employees who are liable for social security contributions, and the national average of 78 top performers is Hamburg (129), Berlin (117) and Bavaria (112).⁵³
- In Saxony, only 35.4% of teachers regularly use digital media in the classroom. In Bavaria, this is 64.4%, Saxony is only just ahead of the bottom bracket Bremen (34%), the national average is at 50%.⁵⁴

Noteworthy for the Saxon educational system are gains of students from other federal states. For the ninth year in a row, Saxony had a gain in 2015, which has more than doubled compared to 2007 with 3,497 students. In 2015, a total of 15,258 undergraduate students, who had obtained their university entrance qualification within Germany, began studying at Saxon universities. 49% of them had acquired the university entrance qualification in Saxony. From other federal states came 7,748 freshmen (51 percent) to Saxony.⁵⁵

In recent years, it can be observed that the number of first-year students is increasing significantly, while the number of apprentices is falling significantly. The IW forecasts for Germany: "If the current qualification structures remain constant over the next few years, demographic change is likely to lead to

⁵¹ https://www.insm-bildungsmonitor.de/2018_best_sachsen_gesamtranking.html

⁵² Statistisches Landesamt des Freistaates Sachsen: Statistisch betrachtet. Hochschulindikatorenj und Berufsakadmien in Sachsen, Ausgabe 2018, S. 20f

⁵³ Vgl. Anger, Christina / Koppel, Oliver / Plünnecke, Axel (2017): „STEM-Herbstgutachen 2017. STEM – Herausforderungen in Deutschland meistern. Institut der deutschen Wirtschaft Köln S. 39ff

⁵⁴ Detusche Telekom: Stiftung Schule digital. Der Länderindikator 2017. Digitale Medien in den STEM-Fächern, Seite 14.
https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&ved=2ahUKewjv5Zfd84_eAhXHZVAKHZXGCdlQFjAAegQlChAC&url=https%3A%2F%2Fwww.telekom-stiftung.de%2Fsites%2Fdefault%2Ffiles%2Ffiles%2Fmedia%2Fpublications%2FSchule_Digital_2017_Web.pdf&usq=AOvVaw2uDY6pf0OHYC8NWb0yVfdr

⁵⁵ Statistisches Landesamt des Freistaates Sachsen: Statistisch betrachtet. Hochschulindikatorenj und Berufsakadmien in Sachsen, Ausgabe 2018, S. 22f

changes in the range of skills offered. In the field of MINT, bottlenecks of skilled work till 2020 in academia is likely to be manageable, also due to increasing immigration in institutions of higher education and rising numbers of new students in recent years. By contrast, bottlenecks are likely to increase until 2020, especially in apprenticeships professions."⁵⁶ For Saxony this can be seen in the field of IT. The backlock and the potential can be seen in the training rates among IT experts in the German average.

Recommended Actions

Action 4: Training and Development

Introduction

In addition to the Saxon Skilled employee strategy, there is the [Skilled employee alliance Saxony](#) consisting of 27 members. Presidency of this alliance is the Saxon State Ministry for Economic Affairs, Labour and Transport. Its main goals are developing jobs characterized by competetibility concurrent good salaries as well as fair working conditions. However, on the alliance's website there is nothing about digitalization. For instance, the section of vocational training only provides links to other entitites but does not inform or sensitize its readers, e.g. by summarizing current or future job challenges. The provided links guide the reader only to national funding or training programs but not to a provincial agency. The national employment agency, for instance, provides a [database for training programs](#), but it does not list the cross-sectional topic of digitalization. In the section of vocational training, there is no program dedicated to digitalization's chances and challenges for Saxony. On the contrary, the Chamber of Industry and Commerce provides a further training database ([Weiterbildungs-Informations-System](#)) which listed 46 programs related to digitalization in Saxony, at the time.

Digitalization comes with chances but concurrent with challenges, too. Even with optimal vocational training, companies are not always capable to cope with its challages. Small and medium-sized companies often simply do not possess the necessary employment capacity.⁵⁷ Hiring personnel can be a solution. In Saxony, there are several funding programs (InnoExpert) with financial incentives for the companies to employ skilled personnel. This is great for mid to long term strategies. However, it is not for urgent short-term reactions. In the German state of Thuringia, there is a funding programm dedicated to hiring (or sending) experts for a short-term period from (or to) industry and science⁵⁸, as the RATIO stakeholder Dr. Robert Weigelt from the Thuringian regional development company explained.

Digitalization's chances and challenges require new competencies. First, they require new competencies due to the usage of new technologies and procedures. Second, they require competencies complementary to the usage, e.g. analyzing and interpreting data but also social intelligence. There must be a push-pull strategy. For pull, the industry must point out its demands not only towards current but also to future employees. Therefore, the industry must exert its influence on schooling. For push, the young must bring in their sense related to digitalization, especially the opportunities. For doing so, the young should get in

⁵⁶ Vgl. Anger, Christina / Koppel, Oliver / Plünnecke, Axel (2018): „MINT-Frühjahrsreport 2018. MINT – Offenheit, Chancen, Innovationen. Institut der deutschen Wirtschaft Köln S. 57

⁵⁷ Arbeitsgemeinschaft Mittelstand (2018, p. 15)

⁵⁸ For an outside-RATIO reference please see the [Thuringian funding programs](#) "Ausleihe von hoch hochqualifiziertem FuE-Personal" as well as "Entsendung von FuE-personal".

touch with industrial challenges during higher education and apprenticeship, for shure, but also during school already. So, education-industry collaboration should be increased.⁵⁹

Even though the young grow up with digital technology and procedures, often they are not able to reveal associations in advertisements' content and marketing context or to protect themselves against threats.⁶⁰ This is why it is important to start with education on digitalization in school, already. Therefore, there is a German strategy on education in the digital world (Bildung in der digitalen Welt) since 2016. Based on this strategy, there is a concept on media education in Saxony since 2017. Its focus is on schooling, vocational training and teacher training. For schooling, the perspective is to embed digitalization in the curriculum with the aim of media education as a transformation process. More precisely, computer science shall be taught at the beginning of secondary schools.⁶¹ If the concept is realized as described, Saxony puts media education on a solid base. However, there is room for improvement even in the concept. For instance, it lacks on cross-subject content of applications at play.

In the coalition agreement of the new federal government, a digital pact was decided upon, on the basis of which the Federal Ministry of Education and the Federal States should implement the financial framework conditions for a better endowment of the schools with information and communication technologies. The possibilities offered here should Saxony use to sustainably improve the IT equipment at Saxon schools and, thus, complement the education efforts related to digitalization.

In order to increase the attractiveness for foreign students schools and universities can implement some cornerstones themselves, conceivable are:

- Development of a welcome culture (English language courses),
- Development of scholarship programs for foreign students,
- Accompaniment of foreign students within the university but also in everyday life, for example through mentoring programs,
- Convincing companies to cooperate with foreign students, to show the opportunities of employing students with a migration biography.⁶²

As shown, immigration for Saxony can be an element of ensuring skilled labor, especially in the MINT professions. The shares of migrants in the MINT professions field in Saxony compared to the national average point to the considerable potential. Detached from the task of developing a migration-friendly culture in Saxony, the following recommendations can be formulated:⁶³

- In order to specifically attract qualified personnel and students, appropriate access routes to particularly affected regions are to be promoted. For example, the "MobiPro-EU" funding program is one such thing. It is aimed at persons between the ages of 18 and 35 who want to an apprenticeship or a qualified employment in a bottleneck profession such as MINT professions in Germany. The program offers language courses and financial support.
- Information about regions where targeted immigration is to be achieved should be improved. Metropolitan regions are well-known and already provide a high incentive for immigration. Rural

⁵⁹ Arbeitsgemeinschaft Mittelstand (2018, pp. 8–9)

⁶⁰ Sliwowski and Grodecka (2013, pp. 39–40)

⁶¹ Staatsministerium für Kultus (2017, p. 29)

⁶² Arajärvi, Outi / Drubig, Roland (2014): VISS – Verbleibsquote interanationaler Studierender in Sachsen". Kurzdarstellung der Ergebnisse und Handlungsempfehlungen, S.10

⁶³ Geis, Wiod, Orth, Anaj Katrin (2016): „Regionale Fachkräftesicherung durch Zuwanderung“, S. 29

regions that are poorer in economic terms and barely enjoy international recognition, need to be brought into focus by providing information. An example is the portal "Make it in Germany"

- As mentioned in the section "Innovation and technology transfer from higher education", the recruitment of foreign skilled workers should be promoted more strongly. Examples include the support of companies in participating in international job fairs, but also by helping universities with international activities.
- The promotion of apprenticeship in MINT professions of persons from abroad seems to be a useful tool. The qualifications acquired during the apprenticeship correspond to those of the local labor market. Thus, the transition to the labor market is simplified and the trained people remain more likely in Saxony.

Concluding the situational analysis, digitalization will and does change job requirements and, in addition, even jobs itself, already. Therefore, it is recommended to train those employees whose job activities are affected by digitalization, which will be the case for mostly everybody, sooner or later.⁶⁴ Training is key to participate in digitalization's chances. Hence, both internal and external training is a must.⁶⁵ However, training is not always enough. Hiring personnel can be an option, but in Saxony employment funding is binded on minimum contract duration. Educating the young – digitalization will be embedded in the curriculum soon but there is a lack of preparation for problem solving-oriented applications. In a nutshell, the Skilled employee strategy neglects the importance of the cross-sectional topic of digitalization completely.

Background

The subsequent recommendation is rooted in one RATIO approach, two Good practices and one study visit, which are accordingly [Innovation Health Care Tool](#), [Local Enterprise Offices](#) (IR), "Creativity applied to innovation through improvement of human resources capacities in SMEs" (IT) and [Skillnet Ireland](#) (IR).

The Innovation Health Care Tool is a company survey tool developed by Enterprise Ireland. It was not only used by all project partners within RATIO but also by various Enterprise Europe Network groups. This tool enables evaluating the innovation processes of companies, especially small-and medium sized companies. Participating companies must answer about 50 questions related to their innovation activities and their innovation environment. For doing so, they can be assisted by people administering the tool in their region, e.g. the Aufbauwerk Region Leipzig GmbH or participating Enterprise Europe Network groups. As outcome, participating companies receive an evaluation on both their company's scores and their relative position in the database of all participating companies. In addition, they receive a company-specific recommendation on potential improvements. So, the companies receive a direct reward for participating in the Innovation Health Care Tool. In addition to the Innovation Health Check, Enterprise Ireland offers a Marketing Health Check and a Workplace Innovation Toolkit, too.

Local Enterprise Offices offer a wide range of services, but the most relevant for our recommendation are: high quality training meeting the specific needs of the businesses, advice on local authority regulations, planning, accessibility, environment as well as mentoring program. So, the Local Enterprise Offices provide mostly general business advice.

⁶⁴ Weinreich (2016, p. 172).

⁶⁵ acatech, Fraunhofer IML, equeo GmbH (2016).

Skillnet Ireland complements this by facilitating learning networks consisting of companies coming from the same region or facing the same challenges. At the time, Skillnet Ireland allocated funding to 65 learning networks. By doing so, the networks benefit from group discounts, knowledge spill-overs and networks. Skillnet Ireland focuses on current but also future skill needs and, thus, on digitalization-related skill needs. It is not only a RATIO Good practice but is also recognised by the OECD and ILO.

The RATIO good practice Hennlich S.R.O (CZ) participates in a push-pull mechanism. They engage in it via offering internships, apprenticeships, student trainee positions and theses. One of RATIO's external stakeholders, Dr. Robert Weigelt, referred to a Thuringian pilot project called [Digitalization Scout](#). The Scouts are apprentice who elicit their company's digitalization potential and realize one of them. For doing so, they get a mentor within the company and up to six months to work on their project. Both the apprentice and the mentor, in turn, get a coach by the project's administering authorities. In the end, the apprentices are awarded with a certificate.

Within RATIO, we have been told about a few programs on bringing digitalization into schools. The ones we appreciate most are School with Class 2.0 (PL), Coding Masters (PL), #SuperCoders by Orange and Devoxx4Kids (Thuringia). What we value is that they focus on developing students' skills rather than introducing the usage of devices in class or just providing infrastructure. School with Class 2.0 aims at both teaching how to use ICT in the learning process and developing digital skills. The students are trained in critical thinking and applying their knowledge. This is exactly where Coding Masters ties in. This initiative brings programming classes to school. #SuperCoders is a program by Orange Group offering free coding workshops. Devoxx4Kids organizes events where kids can develop computer games, program robots and even get insights into electronics.

Action

Based on the RATIO project, we recommend the following actions:

- | | |
|----------------------------|--|
| 4.1. Company Health Check | Measuring company competitiveness |
| 4.2. Hire an expert | Labor leasing for the short term |
| 4.3. Learning Networks | Offering vocational training effectively and reasonable priced |
| 4.4. Digitalization Scouts | Apprentice realizing companies' digitalization potential |
| 4.5. ICT driver's license | Driving digitalization playfully |

Action 4.1. Company Health Check

- Introduce the Action 4.1. Company Health Check all over the province. Therefore, train the entities offering the Company Check in conducting the check. This will give the companies the opportunity to benchmark their activities and, thus competitiveness, with others in the region and even in Europe. The questions itself, the result and the company-specific recommendation will sensitize the companies for current and future chances and challenges.
- Complement the questionnaire with digitalization-related questions to grasp the companies' digitalization readiness.

Players involved

- **Presidency:** Saxon State Ministry for Economic Affairs, Labour and Transport
- **Advising entity:** Enterprise Ireland (or Aufbauwerk Region Leipzig GmbH)
- **Trained entities:** Enterprise Europe Network groups
- **Coordinating authority:** Aufbauwerk Region Leipzig GmbH, if necessary

Timeframe and Costs

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Training phase: Online training for the participating entities offering the Company Health Check conducted by Enterprise Ireland or the Aufbauwerk Region Leipzig GmbH itself. Optionally, exchange of experience between trained personnel and an Enterprise Ireland Instructor within a regional or international RATIO meeting.	- (EUR 1,000)	- -
2019/04- 2019/06	Testing phase with several selected companies close to the Aufbauwerk Region Leipzig GmbH or Enterprise Europe Network groups	-	-
2019/07- 2020/03	Launch and realization of the Company Health Check	-	-
Sum		(EUR 1,000)	EUR 0

Action 4.2. Hire an expert

- Add a funding program to the umbrella program of InnoExpert supporting short-term exchange of experts to and from industry or science, based on the two Thuringian funding programs mentioned previously. This funding should fund 50% of the personnel costs, but maximum EUR 60.000, up to two years. So far it is debatable, whether employees of labor leasing agencies should be eligible. Either way, this program will enhance the companies' flexibility reacting to challenges in the short term. Moreover, this program will foster knowledge and technology transfer via people. Due to the established social linkage, collaboration between the sending and receiving entity are more likely than without this exchange.

Players involved

- **State Ministries:** Saxon State Ministry for Economic Affairs, Labour and Transport
- **Authority administering the funding program:** Sächsische Aufbaubank (SAB) or futureSAX, Thüringer Aufbaubank (TAB)
- Coordinating authority: Aufbauwerk Region Leipzig GmbH, if necessary

Timeframe and Costs

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Evaluation of the economic impact of the recommendation on the companies's labor structure	(EUR 5,000)	t.b.a.
	Exchange of experience between the responsible authorities in Saxony and Thuringia	(EUR 2,000)	t.b.a.
2019/04- 2019/06	Development of the funding program	-	-
2019/07- 2020/03	Launch and relaization of the Funding program	-	-
Sum		(EUR 7,000)	t.b.a.

Action 4.3. Learning networks

- Support facilitating learning networks, following the good practice of Skillnett Ireland. There must be an authority administering the learning networks, e.g. futureSAX. Until the launch of the Innovation Link Portal, the authority in charge will administer the learning network. Once launched, the Innovation Link Portal will facilitate the creation of the networks based on the companies' demands. It is debatable, whether and if so, for whom the posted demands are visible. The reason is that the posting could be considered as sensitive information giving insights into the company's situation. As proven by Skillnet, these learning networks contribute by reducing the external training costs, fostering knowledge and technology transfer and increasing the company's network.

Partners involved

- **Presidency:** Saxon State Ministry for Economic Affairs, Labour and Transport
- **Coordinating entity:** Aufbauwerk Region Leipzig GmbH, if necessary
- **Advising entity:** Skillnet Ireland
- **Entity administering the learning networks:** future SAX

Timeframe, costs and funding

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Employment of one full time equivalent	EUR 60.000	(EUR 30.000)
	Exchange of experience between the responsible authority in Saxony and Skillnet Ireland via web conferences or even a regional or international RATIO meeting with Skillnet as a stakeholder	(EUR 2,000)	ESF Technologieförderung 2014-2020 (Transferassistent)

2019/04-	Launch	-	-
2019/06	Advertizing and networking	3,000	
2019/07- 2020/03	Realization of the Funding program	-	-
Sum		EUR 63,000	EUR 33,000

Action 4.4. Digitalization scout

- Launch a Digitalization scout project based on the Thuringian pilot project “Digitalization scout”. Therefore, agree on a strategic collaboration partnership with the Thuringian counterpart to officially commit exchange of knowledge. This could imply sharing additional material, e.g. supporting E-learning material. Moreover, get the [Mittelstand 4.0 Kompetenzzentrum Chemnitz](#) on board, too. This center of excellence provides information, advice and training on 4.0 topics, e.g. industry or labor 4.0. Their services will add great value to the project and, thus, attract more companies to engage in this Digitalization project.

Partners involved

- **Ministries:** Saxon State Ministry for Economic Affairs, Labour and Transport, Thuringian Ministry for Economic Affairs, Science and Digital Society
- **Administering authority:** Chambers of Industry and Commerce Leipzig, Dresden, Chemnitz
- **Centers of excellence:** Mittelstand 4.0 Kompetenzzentrum Chemnitz, RKW Kompetenzzentrum

Timeframe and Costs

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Collaboration partnerships with the Free State of Thuringia and the Mittelstand 4.0 Kompetenzzentrum Chemnitz on the Digitalization Scout project Exchange of experience between the responsible authority in Saxony and the Thuringian authority RKW Kompetenzzentrum	- EUR 500	-
2019/04- 2019/06	Development of supporting material, e.g. ELearning material Advertizing and networking	10,000	t.b.a
2019/07- 2020/03	Pilot project phase with one cohort of apprentice	-	-
Sum		EUR 10,500	EUR 10,000

Action 4.5. ICT driver's license

- Develop a cross-subject program on applying information and communication technologies (ICT). Its focus shall be on problem solving-oriented application at play. It should prepare students for real world challenges. The program shall be offered at schools, but voluntarily such as an afternoon work group. At the end shall be a certificate displaying the programs contents. For the sake of advertising we suggest the wording of ICT driver's license in accordance with the bicycle safety test and the driver's license for the car.
- Develop the program rather as a framework than a complete new course because there are several offers available already. We recommend #SuperCoders by Orange, LEGO Mindstorm work groups⁶⁶ and devoxx4Kids.
- Encourage participating schools to agree on collaboration partnership with local Universities (of applied sciences), research institutions and companies to work on given case studies at play. This will sensitize the students for real word applications. Moreover, it will make them more open towards digitalization related chances and challenges.
- Encourage participating schools to agree on collaboration partnership with entites organizing hackathons to include a kids track, too
- To promote this program, launch a Digital school specialization like "Bewegte Schule", which awards schools proving outstanding commitment to digitalization.

Partners involved

- **Ministries:** Saxon State Ministry for Economic Affairs, Labour and Transport, Sächsisches Staatsministerium für Kultus
- **Authority responsible for program's content:** Landesamt für Schule und Bildung, Sächsische Bildungsagentur, Sächsisches Bildungsinstitut
- **Partner entities:** School with Class 2.0, #SuperCoders, LEGO Mindstorm League, Devoxx4Kids
- **Centers of excellence:** Mittelstand 4.0 Kompetenzzentrum Chemnitz, RKW Kompetenzzentrum

Timeframe and Costs

Time	Milestone	External Costs	External funding
2018/11- 2018/12	Preparation phase	-	-
2019/01- 2019/03	Exchange of experience Collaboration partnerships with existing programs for exchanging of knowledge or even including in the program, e.g. School with Class 2.0 or Devoxx4Kids	EUR 1000.00 -	-
2019/04- 2019/07	Development of program's material	10.000	t.b.a
2019/08- 2020/02	Pilot project phase	-	-
Sum		EUR 11,000	t.b.a

⁶⁶ LEGO Mindstorm work groups are an outside-RATIO good practice, e.g. offered at Martin-Andersen-Nexö-Gymnasium Dresden.