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ERA THEMATIC DOSSIER „DIGITAL“
(INFORMATION AND COMMUNICATION TECHNOLOGIES)

TABLE OF CONTENT

1 INTRODUCTION AND OBJECTIVES

This ERA Thematic Dossier gives a picture of the current development status of Information, Communication and, more in general, Digital Technologies (ICT, DT) in the context of European Research and Development strategies as well as the Austrian contribution to it.

In particular, the dossier takes a closer look at:

- The European Policies and Strategic frameworks The implementing actions and budget committed to ICT and DT in Horizon 2020 to date (i.e. calls for proposals in 2014-2018)
- The Horizon 2020 related Partnership Initiatives, such as Art.185, contractual Public Private Partnerships, FET Flagships, Joint Undertakings etc.
- The performance of Austria at large in ICT in H2020 up to date

Moreover, this document provides an outlook on ICT/DT in the next European Research Funding Framework Program, Horizon Europe (HEU), and linked Programmes with the upcoming core areas of intervention in Digital Research and Development.

The above provided information is then used as a knowledge base to deduce some strategic observations, which can contribute to shape future R&D policies and activities at national level.

Where appropriate, the ERA Thematic Dossier Digital references to the first iteration of this document, the "IKT Themendossier[1]" (in German) from 2015, to better understand changes in the ICT landscape and developments in topics. The Annex lists "Observations/Recommendations" from 2015 and how they have been implemented.

The analysis and views expressed stem from careful considerations of facts and discussions at various levels. The authors want the conclusions and observations to be understood as *food for thought* and – where necessary – as a stimulus to trigger deeper analysis or actions.

[1] https://www.ffg.at/sites/default/files/downloads/page/era_themendossier_ikt_1.pdf

2 EXECUTIVE SUMMARY

This thematic dossier presents a compact overview of the positioning of Austrian Information, Communication and Digital Technologies (ICT/DT) performance in the European Research Area from the perspective of the Austrian National Contact Point. The dossier covers Horizon 2020 (H2020) from its start to the result available for the first call of the Working Program 2018-2020 (July 2018).

Results overview

The policy background from the European Commission is analysed, showing a heterogeneous landscape of initiatives related to the ICT/DT funding strategies. The Austrian situation is similar, with several initiatives properly implemented to keep pace with the challenges of the Digital Era, but with a lack of homogenous coordination.

The Austrian performance in H2020 is very good in terms of country success rate (16.9%), i.e. the number of granted participant organization out of all the applicant from the country, which is above the European average. If we restrict the pool to the ICT topics, the contribution is even higher (than the average national rate. A detail analysis of the topic which have been funded reveals a "core" area (Photonics, Robotics, Advanced Computing) where Austrian organisations have been very successful from the beginning of H2020, in continuum with the FP7 success story. A network analysis of how organisation are connected to each other in the core area projects also reveals different situations, where some key players are very tightly connected and drive the successful projects together (e.g. in Photonics), while other community are dominated by a single approach of each organisation (e.g. in Robotics). The counterpart to the core area is a group of new emerging topics (5G, Next Generation Internet, Blockchain, Digital Platforms and Hubs), for which data are from fewer and more recent calls, where Austrian organisations already have a very good performance.

Key conclusions

Austrian organisation are performing very well in securing EU funding, compared to the European average. ICT remain a pillar of Austria's capability. After an early success in core areas there is a need to keep such area on the top performing level. An effective improvement in this direction would be providing incentives for more intense collaboration. In the same time, the rapid success in new trend topics shows a good capability of grasping new trends in digitalisation. A need to implement a more coherent policy strategy approach also emerge, in order to align the different digitalisation strategies to a successful R&D support plan toward an even more complex Digital funding landscape in the next European Framework Program (Horizon Europe).

3 POLICY CONTEXT

National funding and support measures have been, and are increasingly influenced by European policies, therefore a closer look on the policy context of ICT/DT is first given in the following paragraph.

3.1 EU Policies

The activities and actions on Information, Communication and Digital Technologies distributed over the different pillars of Horizon 2020 are based on a number of high-level European policies dealing with innovation and competitiveness in the wider sense, as well as with ICT and digitisation in the narrower sense.

The comprehensive EU policy is the **Europe 2020 strategy**[2], which sets the strategic framework for the European research and innovation policy.

One of the ICT relevant flagship initiatives of the Europe 2020 strategy is the "**Digital Agenda for Europe**", which (among other objectives) aims at creating a common digital single market, a common infrastructure (broadband) and a better investment in research and innovation.

Key pillars of the Digital Agenda in the area of ICT are the Digital Single Market Strategy (DSM) and the Digitization of the European Industry (DEI).

The **Digital Single Market strategy**[3] endorses open science and open access to scientific results. It aims at providing European science, industry and public authorities with excellent digital infrastructure - supercomputing and data storage. Measures on High Performance Computing (HPC), Big Data or Broadband Connectivity (Broadband Europe) are discussed in this strategy.

Within the **Digitising European Industry**[4] (DEI) initiative, the European Commission is constantly taking steps to ensure that every company in Europe, regardless of sector and location, benefits from digital innovation. This is realised by activities such as the creation of pan-European networks of Digital Innovation Hubs (DIH), measures for education and training on digital skills, as well as investment in 5G (European 5G Roadmap), Cloud Computing (European Cloud Initiative), Internet of Things, Cybersecurity and Quantum technologies.

The multiplicity of policies/strategies derives from the fact that different measures are initiated within the European Commission by different Directorates-General (DG). The main actors for these policy areas are the DG for Research, Science & Innovation (DG RTD), the DG for Internal Market, Industry, Entrepreneurship and SMEs (DG

[2] https://ec.europa.eu/digital-single-market/en/europe-2020-strategy
[3] https://ec.europa.eu/digital-single-market/en/policies/shaping-digital-single-market
[4] https://ec.europa.eu/digital-single-market/en/policies/digitising-european-industry

Growth) and the DG for Communications Networks, Content and Technology (DG Connect). Hence, synergies between the policies might often be argued ex-post, each time a new policy is defined. This leads to a level of complexity in the policy framework that national policy actors and the research and innovation community at large have to deal with.

The **EU Research and Innovation Program Horizon 2020**[5] is an essential instrument for **implementing** the strategies just mentioned. It supports the promotion of research an innovation activities aimed at strengthening the scientific and technological bases of the European industry and the development of its international competitiveness.

Targeted investment in ICT research and innovation at EU level is an essential prerequisite for building industrial European leadership in various areas of application, such as e.g. mobile communications, safety-critical ICT systems, etc. Thus, the ICT program in the "Industrial Leadership" pillar also includes Key Enabling Technologies like Micro- and Nano-electronics and Photonics. At the same time, ICT makes an important contribution to address key Societal Challenges (for example demographic change and wellbeing, transport or secure societies), as well as providing important research and innovation infrastructures, such as broadband networks and supercomputing capacity. This fragmentation shows the challenge for ICT proposers even within the ICT topic.

In addition to Horizon 2020, there are other programs with ICT relevance such as the Connecting Europe Facility or the **Creative Europe Media** programme which supports the European audio-visual industry.

The Telecom part of the **Connecting Europe Facility**[6] (CEF) is an EU instrument to facilitate cross-border interaction between public administrations, businesses and citizens, by supporting the deployment of digital service infrastructures (DSIs) and broadband networks.

With increasing number, initiatives cannot be realised on a European level alone but need joint efforts of Member States (and often Industry) as well. Therefore, understanding intentions and background of new European initiatives is of utmost importance for national policy makers and supporting institutions. We do notice that national initiatives are more and more linked to (or even based on) European ones, which makes it even more important that Member States are involved in the early design phase of new initiatives coming from EU.

Consequently Austria has to be prepared for setting up national processes to contribute with high quality feedback, concerted with the relevant national stakeholder and quite often in a short period of time.

[5] https://ec.europa.eu/programmes/horizon2020/en/
[6] https://ec.europa.eu/inea/en/connecting-europe-facility

3.2 Austrian national policies

In 2011, the Austrian federal government started to follow the **"Strategy for Research, Technology and Innovation"**[7]. The aim is to push Austria from the group of *Innovation Followers* into the group of *Innovation Leaders*, the most innovative countries in the European Union. Furthermore, a Research and Development investment quota of 3.76% of gross domestic production (GDP) should be achieved by 2020. In general, the Research and Technology Report 2018[8] shows that Austria is on the right track towards becoming an "Innovation Leader" (e.g. with an overall economic R&D ratio of 3.09% of the GDP in 2016). However, there are only few and relatively imprecise measures regarding the ICT sector listed, such as "... *further development of generic knowledge and generic technologies, such as information and communication technologies (ICT)*".

In Austria, several ministries are dealing with ICT and Digital Technologies. Correspondingly, a large number of strategies and measures dealing with subsections of digitisation have been initiated in the past: the **eGovernment** Initiative 2012-2014 under the auspices of the Federal Chancellery (BKA), the **Broadband Strategy 2020**[9] or the 5G Strategy[10] for achieving a nearly nationwide coverage with broadband Internet by 2020 by the Ministry for Transports, Innovation and Technology (BMVIT), or the eFit21[11] - Digital Agenda for Education, Art and Culture by the Ministry of Education and Research (BMBF, currently named BMBWF). Following those strategies, Austria was able to achieve good results in certain areas: e.g., the eGovernment ranked 6th out of 34 countries in the European top group, while Domestic eGovernment solutions such as FinanzOnline or Justice 3.0 have been recognised as Best Practices for Europe). Nevertheless, like what happens on the European level, an overall coordinated strategy for ICT was/is missing.

For the first time in 2016, with the formulation of the **Digital Roadmap Austria**[12] (**DRA**), the activities of all ministries were bundled in a joint strategy of the Federal Government. The roadmap provides an overview of the current challenges as well as an action plan based on twelve guiding principles for the design of digitisation in Austria. One focus of the DRA is on research and innovation, including activities such as the continuation of existing successful research, technology and innovation programmes (e.g. ICT of the future) or reinforcement of specific research priorities (e.g. Quantum Technology).

With the establishment of the Federal Ministry for Digital and Economic Affairs (BMDW) in January 2018, the topic of Digitisation is coordinated in one ministry. Furthermore, the launch of the **Austrian Digitisation Agency** (DIA) at FFG, which is a central platform for important digitisation measures in order to tackle the challenges

[7] https://era.gv.at/directory/158/attach/RTI_Strategy.pdf
[8] https://www.bmvit.gv.at/en/innovation/publications/technology_reports.html
[9] https://www.bmvit.gv.at/telekommunikation/breitband/publikationen/bbs2020.html
[10] https://www.bmvit.gv.at/en/service/publications/downloads/5Gstrategy.pdf
[11] http://www.efit21.at
[12] https://www.digitalroadmap.gv.at/

of digital transformation, shows some effort towards a centralised coordination of activities.

The newly published common vision on "**Artificial Intelligence Mission Austria 2030**" - Shaping the Future of Artificial Intelligence in Austria, November 2018), can be seen as a good example for coordinated approach in developing strategies within Austria, and compatible with EU policies.

Nevertheless there are still many distinct policy actors in Austria dealing with ICT and Digitisation, which make it quite difficult to reduce the complexity of developing concerted ICT strategies (see Table 6 on page 32).

4 THE AUSTRIAN ICT PERFORMANCE NATIONAL AND EUROPEAN

Europe has set itself the goal of assuming or retaining global leadership in key enabling technologies to meet both technological and socio-economic changes by 2020.

Horizon 2020, with nearly 80 billion EUR of funding available over 7 years (2014 to 2020), is the financial instrument implementing this flagship initiative aimed at securing Europe's global competitiveness. The program is based on three thematic Pillars (*Excellent Science*, *Industrial Leadership* and tackling *Societal Challenges*), which are structured in specific topics, as well as a series of correlating funding initiatives (see Figure 1).

In particular, the Information and Communication Technologies (ICT) sector represents 4.8% of the European economy. It generates 25% of the total business expenditure in research and technological development (RTD), and investments in ICT account for 50% of all European productivity growth[13]. Moreover, EU investments in ICT research and innovation increased by about 25% under Horizon 2020 compared to the previous Research Framework Program (FP7).

Information and Communication Technologies underpin innovation and competitiveness across private and public sectors and enable scientific progress in all disciplines. To achieve this goal, the EU has now redistributed the ICT-related programs and initiatives bundled in previous research funding programs into all priorities of the three pillars of Horizon 2020 (more details are provided Figure 2).

Within the *Excellent Science* pillar, Future and Emerging Technologies (FET) are supposed to go beyond their historical role of path-finding in information technologies, opening up to all technologies thus strengthening multidisciplinary aspects to turn Europe's excellent science base into a competitive advantage.

Research and innovation activities on generic ICT technologies are either driven by industrial roadmaps or through a bottom up approach are addressed in the *Industrial Leadership* pillar, more specifically in the 'Leadership in enabling and industrial technologies' (LEIT) part, under the programme *Information and Communication Technologies*. In particular, the topics addressed in the first two years of the programme cover the ICT value chain in a comprehensive way, from key enabling technologies up to content and information management technologies, robotics and networking technologies. Several cross-cutting topics addressing cyber-security, Internet of Things and research on a Human-centric Digital Age are included. All activities are complemented with policy support, innovation take-up and international cooperation.

A number of essential EU policy objectives on health, ageing, climate, environment, energy, transport, public sector modernisation, security cannot be achieved without

[13] https://ec.europa.eu/programmes/horizon2020/en/area/ict-research-innovation

ICT innovation. ICT also invades and transforms bit by bit all aspects of our societies and economies and change the way people live and behave. Multi-disciplinary, application-driven research and innovation actions leveraging ICT to tackle societal challenges are included in the different 'Societal Challenges' parts of the programme.

Figure 1 shows the current situation or 'ICT landscape' in ICT programmes and accompanying initiatives.

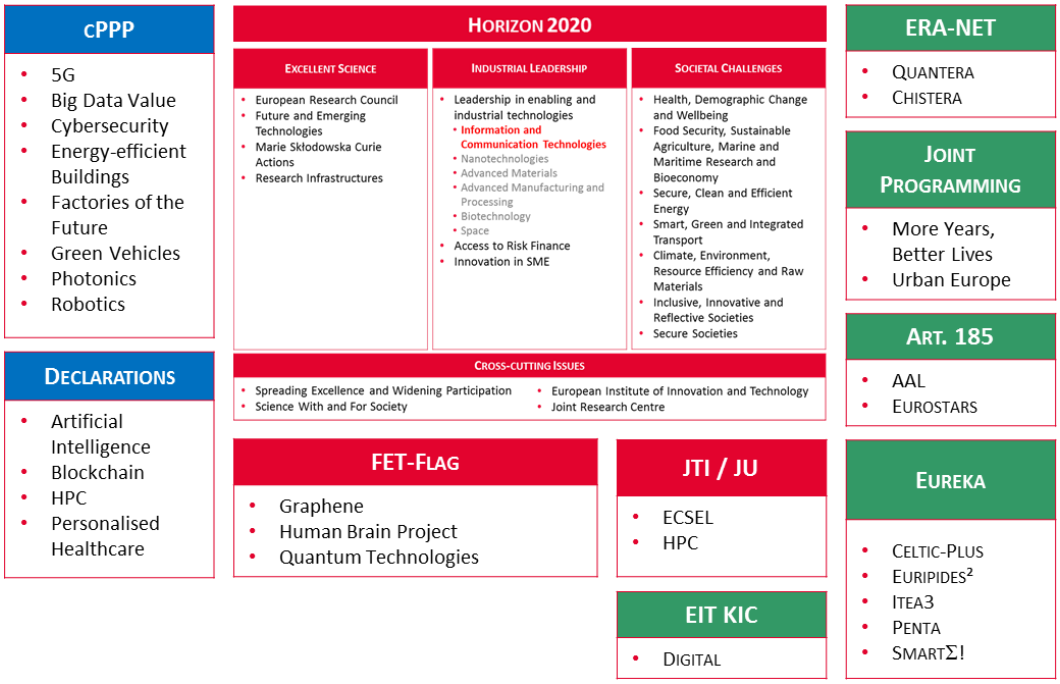

Figure 1: Horizon 2020 landscape of funding programmes (red: Horizon 2020 funding programmes, green: other related funding programmes, blue: institutionalised networks and initiatives)

ICT topics in the "Excellent Science" pillar

Promoting visionary and risky projects is at the heart of the Future and Emerging Technologies (FET) program in the Horizon 2020 pillar *Excellent Science*. Funding is provided for interdisciplinary projects dealing with the development of future technologies, both bottom-up (FET Open) and top-down (FET Proactive). The current FET program includes three specific large-volume measures (FET flagships) that are strongly related to ICT: the Human Brain Project, Graphene and Quantum Technologies. Furthermore, this pillar invests in research e-infrastructures such as large scientific databases, high-performance computers or lately the establishment of the European Open Science Cloud.

ICT topics in the "Industrial Leadership" pillar

The Industrial Leadership pillar includes, on the one hand, measures to ensure sustainable support for medium and long-term research strategies of the European ICT industry, and on the other hand, mechanisms are provided to promote fundamental innovation and rapid implementation of excellent research results for the market. It is striking that in the ICT sector a particularly large number of contractual Public-Private Partnerships (cPPP) exist - another indication of the industry orientation of the program. Examples include Robotics21 and Big Data Value Association as well as ICT-related initiatives such as Factories of the Future in the NMP programme, which publishes cross-thematic calls for proposals. The cPPP Future Internet has expired and its topics have been partially taken over by the cPPPs for 5G and Big Data.

ICT topics in the "Societal Challenges" pillar

In the third pillar *Societal Challenges*, ICT is making an important contribution to tackling key societal challenges by integrating technologies into specific areas of application. About 20% of the ICT budget is invested in these areas. It supports ICT-based solutions on active aging, energy efficiency, urban development, intelligent transport systems, resource management, security and more.

Figure 2: Digression on the objectives of the three main pillars of Horizon 2020

The budget distribution of the Directorate-General for Communications Networks, Content and Technology (DG Connect) over the three pillars of H2020 (see Figure 3) shows that the more than 2/3 of the total budget is allocated to Pillar 2 *Industrial Leadership*, in one the so called *Leadership in Enabling and Industrial Technologies* topics, i.e. ICT LEIT.

Something less than 1/4 of the budget is allocated to pillar 1 *Scientific Excellence*, in particular on FET and Research Infrastructures calls, while the remaining 10% is allocated to ICT-related topics in pillar 3 *Societal Challenges*.

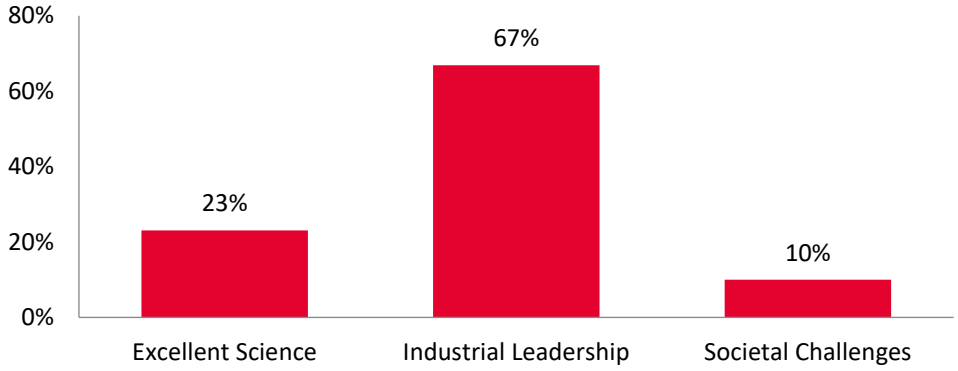

Figure 3: Distribution of "ICT budget" (supported directly by DG Connect) across the three pillars of Horizon 2020 (data: 01/2014 - 04/2018)

4.1 Austrian ICT in Horizon 2020

4.1.1 Overall Austrian performance in ICT

The Austrian performance in H2020 is very good in terms of country success rate (16.9%), i.e the number of granted participant organization out of all the applicant from the country, which is above the European average (14.7%).

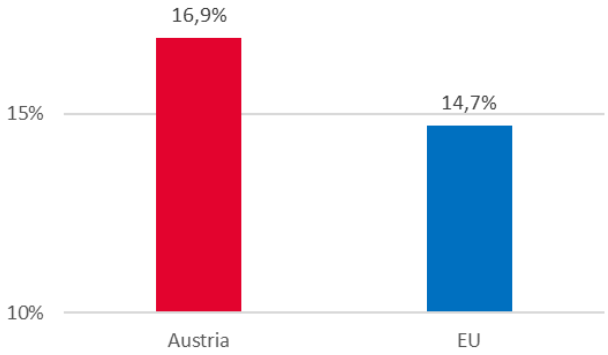

Figure 4: Austrian success rate overall in Horizon 2020 compared to the average of all countries

The whole pool of projects in the ICT area is a top contributor to the Austrian successful performance in H2020, second only to the ERC received grants, and together with the funded projects in Transport applications it is one of the three areas that secured more than 100 M€ research funds to Austria.[14]

If we restrict the pool to the ICT LEIT topics, i.e. related to the biggest proportion of the ICT allocated budget in Pillar 2 of H2020, the contribution is even higher (18.1%) than the average national rate (Table 1).

[14] https://www.ffg.at/sites/default/files/allgemeine_downloads/Statistik/ffg_performancebericht_h2020_2018.pdf

	Participations		Coordinations		Funding		Success
	number	share	number	share	mn EUR	share	rate
All countries in all **Horizon 2020** programmes	77.506	100%	17.345	100%	30.590	100%	14.7%
Austria in all **Horizon 2020** Programmes	2.188	2.8%	439	2.5%	871	2.8%	16.9%
All countries in **ICT LEIT** (incl. JTI ECSEL)	9.679	100%	1.406	100%	3.848	100%	13.6%
Austria in **ICT LEIT** (incl. JTI ECSEL)	350	3.6%	55	3.9%	129	3.3%	18.1%

Table 1: The Austrian participation in Horizon 2020 and the share of ICT-LEIT (included ECSEL)

Organisation	EC contribution
TOTAL AUSTRIAN FUNDING IN ICT-RELATED TOPICS	**€ 176.399.790**
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	€ 15.564.861
TECHNISCHE UNIVERSITAET GRAZ	€ 10.163.707
TECHNISCHE UNIVERSITAET WIEN	€ 9.390.396
INFINEON TECHNOLOGIES AUSTRIA AG	€ 8.830.484
AVL LIST GMBH	€ 5.162.916
UNIVERSITAET INNSBRUCK	€ 4.628.285
TECHNIKON FORSCHUNGS UND PLANUNSGESELLSCHAFT MBH	€ 4.235.088
AMS AG	€ 4.052.663
TTTECH COMPUTERTECHNIK AG	€ 3.747.240
MEDIZINISCHE UNIVERSITAET WIEN	€ 3.591.470

Table 2: Total gain of Austria in H2020 ICT-related topics (incl. ECSEL) and top Austrian organisations in terms of funding (Source: FFG EU-PM, May 2018)

Up to date, a total of 7835 participations from all Member States have been approved in ICT LEIT for funding, of which 208 are from Austria (13.75%). In terms of budget, Austrian organizations have been funded with 2.77% of the total budget available.

Austria performed **below the EU average** when looking at the **success rates** of participations in the ICT LEIT programme at the beginning of Horizon 2020. Recently, numbers show a better performance that could indicate a change in trend (see Table 3).

Year	EU				Austria				
	Participants		Succuss	Funding	Participants		Succuess	Funding	
	submitted	funded	rate	[mn EUR]	submitted	funded	rate	[mn EUR]	[%]
2014	14333	1962	13,69%	€ 791,0	400	53	13,25%	€ 24,3	3,07%
2015	11706	1428	12,20%	€ 583,3	326	38	11,66%	€ 15,5	2,66%
2016	9334	1317	14,11%	€ 473,3	259	29	11,20%	€ 11,9	2,51%
2017	11710	1651	14,10%	€ 474,1	300	40	13,33%	€ 12,1	2,55%
2018	7050	1477	20,95%	€ 685,9	228	48	21,05%	€ 19,6	2,86%
Overall	**54133**	**7835**	**14,47%**	**€ 3.007,6**	**1513**	**208**	**13,75%**	**€ 83,4**	**2,77%**

Table 3: Comparison of performance between EU overall and Austria (Source: European Commission; Data: ICT LEIT in Horizon 2020)

At the same time, Austrian organisations still manage to secure funding above the calculated Austrian "input" into Horizon 2020. Austria therefore is **performing "net positive"** in ICT LEIT.

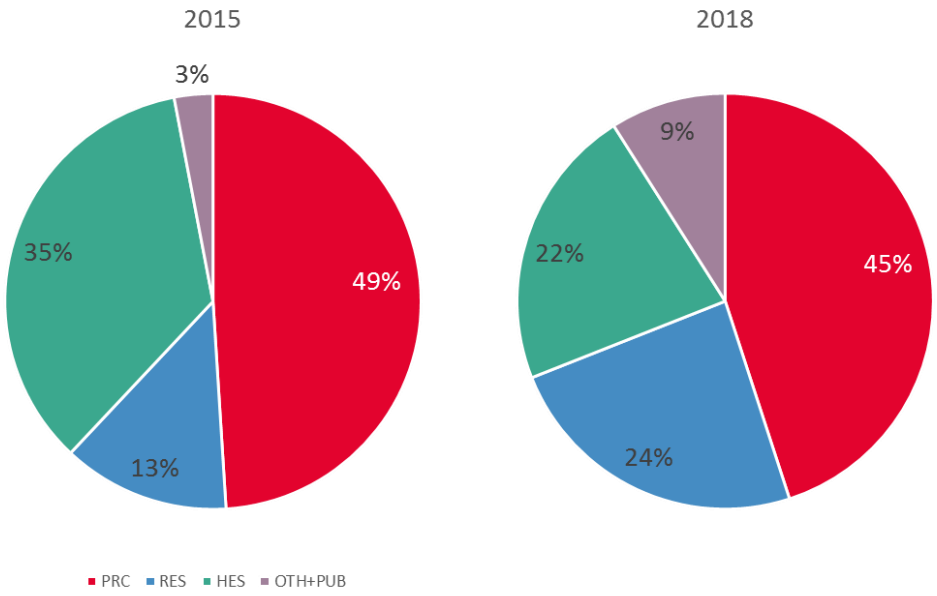

Figure 5: Organisation types in successful projects (Austrian participations; situation 2014-2015 vs. 2014-2018)

Looking at the organisation types of successful Austrian participations there are some **significant changes compared to the situation in 2015** (see Figure 5). While the participation of private (for profit) companies (PRC) remained somewhat stable, the share of participations from the Higher Education Sector (HES) dropped by more than a third. Simultaneously, the share of Research Organisations (RES) increased by nearly 85%. Also noteworthy is the tripling of the "Other organisations" and "Public administration" participations to 9%.

Organisation	EC contribution
TECHNISCHE UNIVERSITAET GRAZ	€ 5.457.044
TECHNISCHE UNIVERSITAET WIEN	€ 4.632.917
TECHNIKON FORSCHUNGS UND PLANUNGSGESELLSCHAFT MBH	€ 4.220.144
AIT AUSTRIAN INSTITUTE OF TECHNOLOGY GMBH	€ 3.853.263
INFINEON TECHNOLOGIES AUSTRIA AG	€ 3.189.895
AMS AG	€ 2.772.638
JOANNEUM RESEARCH FORSCHUNGSGESELLSCHAFT MBH	€ 2.670.064
MEDIZINISCHE UNIVERSITAET WIEN	€ 2.632.752
AVL LIST GMBH	€ 2.280.918
SEMANTIC WEB COMPANY GMBH	€ 2.124.479
PROFACTOR GMBH	€ 2.043.465

Table 4: Austrian top organisations in ICT LEIT (EC contribution above 2mn EUR; data: European Commission until calls with deadline 04/2018 included)

4.1.2 Austrian performance in ICT core areas

The term *core area*, as used in this document, refers to research and innovation areas where Austria has a strong interest and an active community. The selection of these areas has been made by the authors and makes no claim to be complete or accurate from every political or scientific perspective.

The selection is initially based on the first indication of a predominance of projects in certain topics, which we then consider the “core area” of ICT in Austria, that arise from a lexicographical analysis of the topic title in the ICT working programmes.

Figure 6 shows a word cloud compiled of all ICT topics titles that resulted in funded project on European level, while Figure 7 shows the same analysis done considering only the topic titles for which Austria has granted projects.

Already on this macro level, it can be noted that Austrian organisations have been more active and partly very successful in photonics, robotics and smart cyber-physical systems, while other topics which have received significant funds on European level like 5G and Internet-related topics (Future Internet/Next Generation Internet) have very little or no presence in the Austrian landscape.

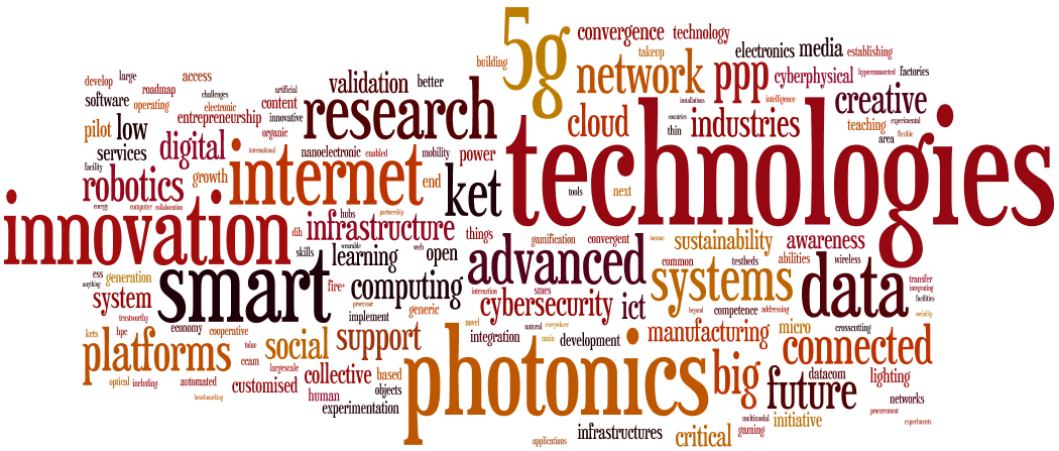

Figure 6: Word cloud of all topic titles funded by EC in ICT-LEIT

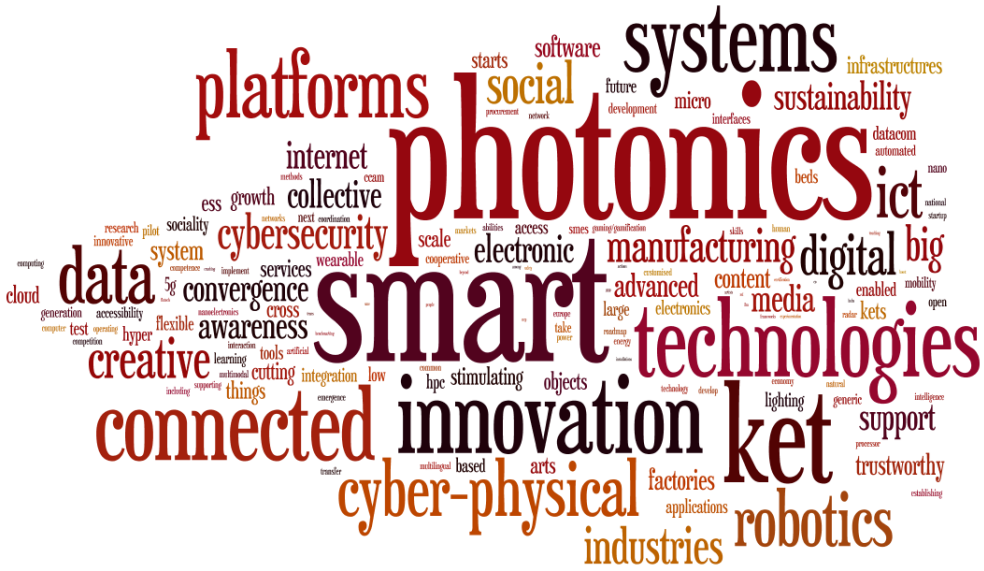

Figure 7: Word cloud of all topic titles granted to AT in ICT-LEIT

Austrian organisations have been actively participating in these core ICT areas since the beginning of Horizon 2020 and quite often well before that (e.g. in the 7th EU Framework Programme). Some key facts and findings on the selected areas are provided below.

New topics or those with recently significantly increased funding are discussed in Chapter 5 *Current and upcoming Core Areas in ICT/Digital*.

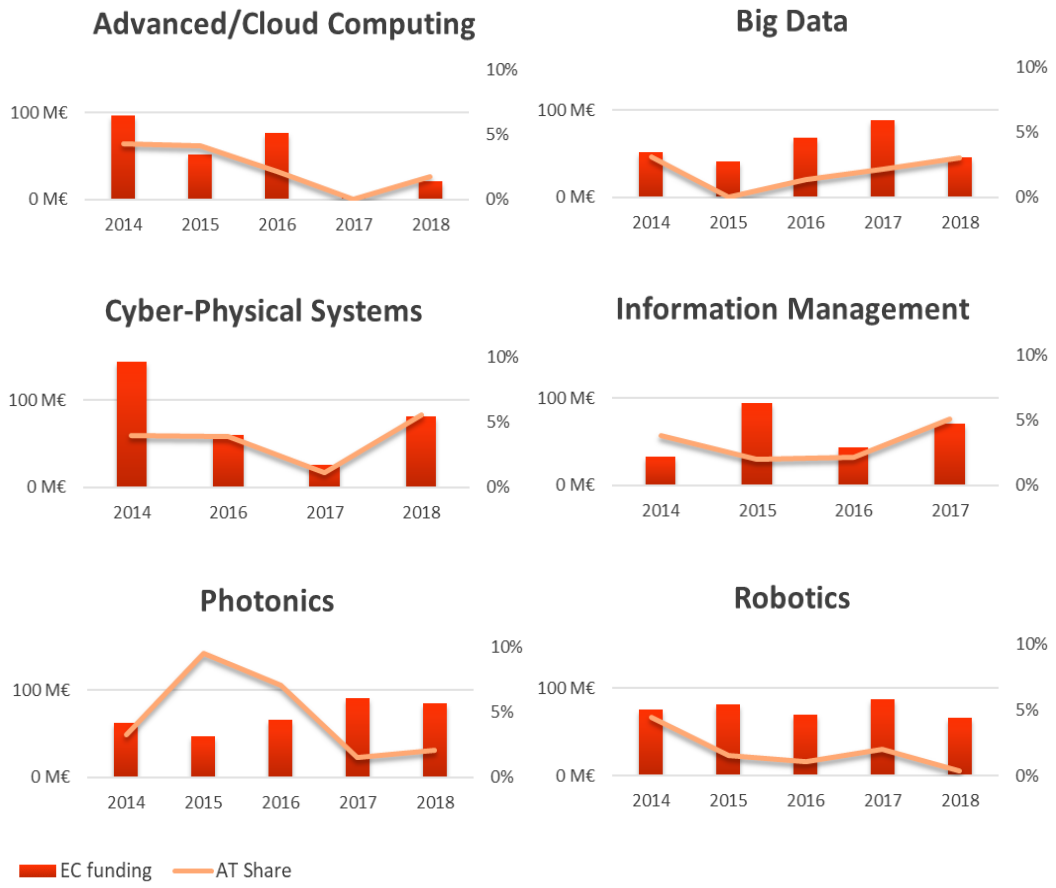

Figure 8: EU Horizon 2020 budget and Austrian share (funding secured) per year in selected core areas in the ICT LEIT Work Programme (source: European Commission; graphics FFG; note: data covers calls with deadlines up to 04/2018)

ADVANCED/CLOUD COMPUTING

Austria has a good history of participation in *Advanced Computing* topics with a substantial 3.3% share of the available funding in Horizon 2020 secured by Austrian organisations and similarly successful participations in former Framework Programmes. That said, it is one of the core areas where there is so far no direct national "mirror platform" reflecting the topic. However, this also reflects the situation in EU R&I policy, as no relevant institutionalised network existed (like a Public-Private-Partnership or a Technology Platform). With the advent of EuroHPC (see chapter 5) it can be expected that the focus of topics within ICT LEIT itself will either change significantly towards edge-computing/cloud-computing (thus away from massive parallelisation or software development tools), or disappear as singular topic altogether. This trend is already reflected in the data on available budget per year (top left graph in Figure 8).

BIG DATA

The Austrian Big Data community is now newly organised within a thematic platform called “Data Intelligence Offensive”, supported by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT). By nature, the Big Data community is very divers with actors ranging from industry (usually providing data and “problem”) and SMEs (typically providing proprietary products or services for open source solutions) via RTD organisations (like the two COMET programme funded Competence Centres “Know Center” and “Software Competence Center Hagenberg”) to several institutes in the higher education sector.

- The EU budget available per year is increasing constantly. It is worth mentioning that other parts of Horizon 2020 also put considerable funds into application driven Big Data projects (e.g. Big Data for Healthcare in the Societal Challenges pillar of Horizon 2020).
- Austrian performance in terms of secured funding is reasonable overall (with a “slow” start in Horizon 2020 and 5.8 M€ funding secured to date), but widely varying between specific topics. Austria is for example a recognized pioneer in the field of B2B data sharing – data economy, contributing this expertise already in various H2020 projects. In general the interest of Austrian organisations in the big data area (as measured in the number of submissions) is increasing.
- Projects submitted with Austrian partner organisations have a higher quality in average than without (59% of the participations have been in projects evaluated above threshold. EU average in Big Data is 53%).

CYBER-PHYSICAL SYSTEM

The Austrian CPS community is well organised and cooperates under the umbrella of the “ECSEL Austria” label, a thematic platform supported by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT) and a mirror group to the Joint Undertaking ECSEL.

- The EU budget available in the ICT LEIT programme was fluctuating (between 26 M€ and 145 M€ per year) as was the Austrian participation in these calls (ranging from only 6 participations in proposals in 2017 to 112 in 2014). The thematic area is closely interlinked with the JU ECSEL (where lower TRL levels are covered in Horizon 2020 and higher TRL levels covered in the JU).
- CPS Research and Innovation is a key area of the Austrian ICT landscape. With strong industrial and academic sectors, it is considered a main driver of the Austrian economy. Austrian organisations performed well overall with 12.9 M€ of funding secured so far.
- It is worth mentioning that the overall quality of proposals is well above average in this thematic area with 62% of all participations rated "above threshold" and Austrian participations evaluated even higher (65% “above threshold”.

INFORMATION MANAGEMENT

This category includes topics like interfaces for accessibility, multimodal interaction and digital content as well as topics for creative industries, technology for better learning and skill development. In this fields, there has been a significant shift from a "semantic technology" to a "big data" focus.

- Austrian organizations have a successful history in this are already since FP7 and have kept a good position - mainly by the activities of key players in science and education. Industrial participation in this area is quite limited (only 2 out of the 18 funded participants).

PHOTONICS

Austrian organisations active in photonics research and innovation closely cooperate within the "Photonics Austria", a thematic platform supported by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT).

- The EU budget available in ICT LEIT per year shows a considerable increase over the last two years.
- At the same time, Austrian performance in terms of secured budget share declined visibly. This follows the engagement of Austrian participants (measured in number of participations) in the respective calls. Still, Austrian organisations performed well with over 4% of the available funding secured overall (peaking at noteworthy 9.5% in 2015).
- It should be mentioned that the Austrian thematic platform prominently participates itself with high success in H2020 photonics projects. This could serve as a role model for other thematic platforms.

ROBOTICS

Austrian robotics organisations network within the "GMAR – Österreichische Gesellschaft für Mess- Automatisierungs- und Regelungstechnik", a thematic platform supported by the Austrian Federal Ministry for Transport, Innovation and Technology (BMVIT).

- While the EU budget available per year remains roughly stable, Austrian performance in terms of success dropped over the years and is underwhelming overall. This despite the continuing interest of Austrian organisations (measured in number of submissions over the years).
- As for the quality of proposals, 43% of Austrian participations have been in projects evaluated above threshold. This is considerably below average performance of Austria in ICT (57%) and below the EU average (46%) in Robotics as well.
- There is a successful Austrian participation in Digital Innovation Hubs for Robotics, but the GMAR (or a subset of the GMAR) did not manage to participate in the call with an organised Austrian approach.

A VIEW ON ORGANISATIONAL NETWORKS

Two significant performance "extremes" in core areas called for a closer look: Photonics is the topic with the overall highest performance in Austrian share (almost 10% in 2015), while Robotics shows an almost constant decrease over the years. As possible impact factors for such trends, we investigated **how the research organizations are partnering** together (consortia of successful projects). In both areas, a cPPP exists to coordinate the respective community internally and its relation with the European Commission.

Figure 9 shows the case of the organisational network of successful Photonics: there is a big cluster of organizations tightly related to each other, and a second smaller one. In both clusters, Austrian participants (highlighted in red) are well connected to the networks' "backbone". This indicates that the field is driven by a very high level of partnership between the relevant players.

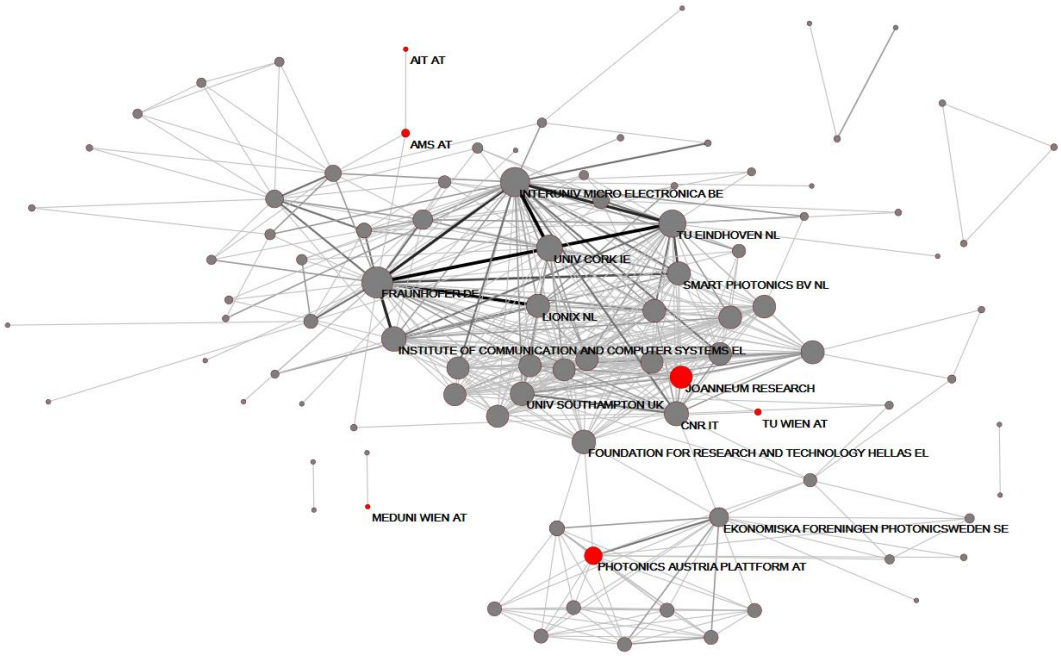

*Figure 9: Networking of European organizations cooperation on **Photonics** (Note: The network nodes represent the participating organizations, lines represent cooperation within projects. The size of the nodes is proportional to the number of all cooperation relations of the organization displayed in the network graphics, the thickness of lines is proportional to the number of cooperation between two nodes; graphics: FFG EU-PM).*

Figure 10 shows the network of organizations that have been granted projects in Robotics. The connectivity is more spars than in the Photonics graph overall, and the Austrian participants are in a relatively marginal position with respect to the key players at the centre of the network. This suggests that the scenario is driven mainly by the own interests and initiative of participants. Therefore, space for improvement in partnerships could be pursued in Robotics.

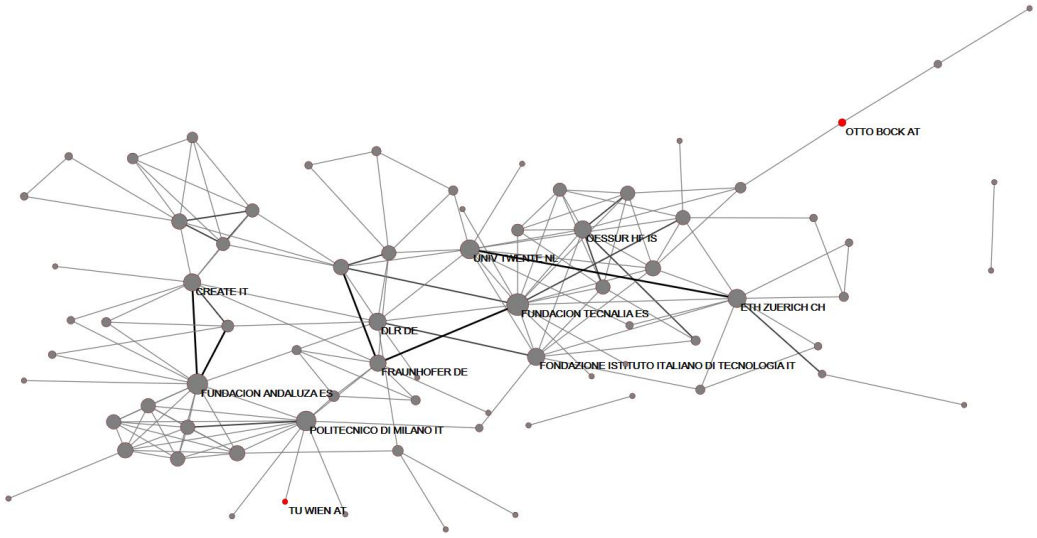

*Figure 10: Networking of European organizations cooperation on **Robotics** (Note: The network nodes represent the participating organizations, lines represent cooperation within projects. The size of the nodes is proportional to the number of all cooperation relations of the organization displayed in the network graphics, the thickness of lines is proportional to the number of cooperation between two nodes; graphics: FFG EU-PM).*

4.2 Austrian ICT Partnerships and strategic initiatives

Next to the core H2020 ICT programme, there are other important ICT initiatives in which Austria is taking part and which are of strategic importance in the funding framework, as described in the following.

JOINT TECHNOLOGY INITIATIVE ECSEL

Austria is particularly successful in the JTI ECSEL[15] on electronic components and systems. Out of the 318 submitted participations of Austrian institutions so far, 150 were successful, which corresponds to an overall success rate of 47.2%. This puts Austria well above the EU average of 32.4%. In terms of budget, the Austrian share is above 6% of the total EU budget for ECSEL, which is an extraordinary performance compared to the average share of 2.77% in Horizon.

EUREKA AND EUROSTARS

Austria is one of the founding members of the EUREKA Initiative, active since 1985. Currently, several million Euro per year of public money are invested in the funding of market-oriented R&D projects with excellent results for Austrian companies and research institutions. Since the start of the co-financed Eurostars-2 programme (March 2014), the Austrian funding authorities have contribute with 16.6mn EUR to

[15] https://www.ecsel.eu/

the programme budget, while Austrian organisations received grants totalling 22mn EUR of funding. In this timeframe, 27 ICT organizations received 8.8mn EUR (40% of the total funding for Austria).

AAL – ACTIVE & ASSISTED LIVING (ART. 185)

Active & Assisted Living / AAL 2 [16] is a funding programme based on Article 185 of the Treaty on the Functioning of the European Union, which aims at increasing the quality of life of older people on the basis of IT-supported products, services and systems. The multi-lateral programme is complemented in Austria by the national funding programme benefit[17].

Austria is particularly successful in the AAL Programme. So far, 186 Austrian Partners have been involved in 85 projects with a funding totalling 37.8 million euros. Since the AAL programmes are co-financed by the European Commission, 16.9 million euros comes from the EU. Altogether, the AAL Programmes have funded more than 220 European projects. This means that Austrian partners are involved in about 40 % of all funded AAL projects, many of them being coordinated by Austrian Institutions.

EIT DIGITAL

EIT Digital is a *Knowledge and Innovation Community* (KIC) selected by the European Institute for Innovation and Technology (EIT) to boost innovation in Europe. Since 2014, EIT Digital has been co-financed by Horizon 2020 funds[18].

EIT Digital operates through “Action Lines” and “Education Action lines”, the former with thematic focus on innovation in *Digital Industry*, *Digital Cities*, *Digital Wellbeing*, *Digital Infrastructure* and *Digital Finance*, and the latter implemented through co-location Centres or "Nodes" .

The possible participation in activities as well as a possible partnership is strongly linked to a "local node". Currently there are the following "Nodes": Brussels Head Office, Berlin Node, Budapest Node, Eindhoven Node, Helsinki Node, Madrid Node, London Node, Paris Node, Stockholm Node, Trento Node and a Silicon Valley hub. No EIT Digital Co-Location Centre or Node is located in Austria.

4.3 ICT on the national level

15% of the total FFG funding volume has been allocated to pure ICT projects (EUR 74.46 millions). Looking more closely at the projects allocated to the ICT sector and supported by the FFG, it is striking that by far the largest number of projects is in the areas of information processing, information systems (more than 27 million euro) and ICT applications (just under 25 million euro). Projects in electronics and

[16] http://www.aal-europe.eu
[17] https://www.ffg.at/programme/benefit
[18] https://www.eitdigital.eu/

microelectronics, which is heavily influenced by the Partnership Initiative JTI ECSEL, follow with around 11 million euros. All other areas are well below a funding volume of 2 million euros per year.
The analysis of the types of organization shows that almost 60% of the FFG's ICT resources goes to companies (PRCs), compared to the overall Horizon 2020 rate of about 52%. The contrary is true for universities and research institutes (including Competence Centres), where the percentage of Horizon 2020 is significantly higher than FFG funding. This is related both to the excellence orientation of Horizon 2020 and to specific national funding programs (such as COMET).
The JTI ECSEL, the AAL initiative and the associated national program highlight the progress made in interlinking national and European funding. The proactive coordination of national ICT programs with European trends has definitely had a positive impact on the performance of Austrian organizations in European programs.

5 CURRENT AND UPCOMING CORE AREAS IN ICT/DIGITAL

This chapter focusses on "Digital" areas that currently receive high attention in the R&I related policy discussion. They must be considered as trend topics that will play an important role in future European funding programmes.

5.1 Current core topics in ICT and the Austrian perspective

5G

The European Commission identifies the 5G standards as one of the five priority areas under the Digitising European Industry initiative. In 2013, the European Commission signed an agreement with the '5G Infrastructure Association', representing major industry players, to establish a Public Private Partnership on 5G (5G PPP), which led to a public funding of 700 M€ throughout Horizon 2020 and recently reached its third and final stage of research and development.

Although set as a crucial strategic investment, the Austrian R&D community has taken part only a marginally in this area, with as little as 0.5% of the available funding secured at the time of this analysis.

ARTIFICIAL INTELLIGENCE

Artificial Intelligence (AI) is newly funded with its own topic in H2020 since 2018. So far, Austrian financial gain from the AI call 2018 is below the AT contribution to the EU budget (1.5 % vs. 2.5%). Austrian AI is financed mainly from the ICT programme (0.3 M€) but also in its more academic stage from the ERC programme in pillar 1.

An important development is the work initiated by groups of the medical establishment, pushing AI into the realm of medical diagnostics (e.g. the Medical University of Vienna[19]). Another key field of application of AI is in robotics, where the Austrian community starts to be active as well. AI usage in classical SSH disciplines is promoted by the newly established ÖAW Artificial Intelligence Initiative[20].

Furthermore, Austria is active in the European High-Level Group on AI[21] with three Austrian experts (Austrian Association Supporting the Blind and Visually Impaired; Austrian Council for Robotics and AI; University Vienna).

Austria so far lacks dedicated national funding programmes for Artificial Intelligence, although in the national "ICT of the Future" Programme, there are from time to time calls that include AI. The establishment of dedicated funding of AI R&D in Austria is strategically desirable, not least with respect to the growing European emphasis on

[19] https://www.meduniwien.ac.at/ai
[20] https://indico.hephy.oeaw.ac.at/event/407
[21] https://ec.europa.eu/digital-single-market/en/high-level-expert-group-artificial-intelligence

acquiring AI capabilities (cf. the proposed funding from Horizon Europe as well as from Digital Europe). While Austria has no dedicated AI funding programme, it is working on a national AI strategy entitled "Artificial Intelligence Mission Austria 2030"[22].

BLOCKCHAIN TECHNOLOGY

The European Commission is seriously looking at the potential of *Blockchain and distributed ledgers technologies* that can change the way organisations and internet users share and exchange data (or value) in many ICT domains and industries[23]. Beyond the hype around cryptocurrencies, the technology is still in a maturation phase and there is a need for more innovation, research, development, piloting and proof of concepts in order to facilitate uptake.

Austria started developing Blockchain expertise at a very early stage. After having one organization as Coordinator of one of the first granted projects in a specific call (in the field of Hyper-connected Sociality), in November 2018 the "world's largest Blockchain competence centre" - the Austrian Blockchain Center (ABC) - has been established in Vienna. The centre aims to bundle comprehensive, interdisciplinary competencies in basic and applied Blockchain technologies in one place. The ABC is funded from national and regional sources as well as from the business sector (54 companies) with considerable participation from the scientific sector (21 institutions) and 17 associated participants (including 16 international institutions and companies). The centre's research focuses include Industry 4.0/Internet of Things, the financial, energy, and logistics sectors, and applications in the public sector and in administration.[24]

CYBER-PHYSICAL SYSTEMS

CPS (with iterations like Embedded Systems or smart CPS) has been and continues to be a main topic within the Austrian ICT research and innovation landscape and a major economic factor. The Austrian success in former framework programmes, in the Joint Undertaking ECSEL, in Horizon 2020 and other programmes is prove of this fact.

The *Silicon Austria Labs*[25] initiative to build a new peak-performance research institution aims at further strengthening the Austrian Electronics sector (that includes CPS). An emphasis should be made to integrate SAL well into the existing platforms so it can act as "lighthouse" initiative well beyond Austrian borders. A fact that has to be observed is that CPS topics are not included in the ICT LEIT Work Programme for 2020.

[22] https://www.bmvit.gv.at/service/publikationen/innovation/ikt/aimat.html
[23] https://ec.europa.eu/digital-single-market/en/news/information-day-horizon-2020-blockchain-distributed-ledger-technologies-topics-and-fintech
[24] https://blockchain-center.at/files/AustrianBlockchainCenter_PressRelease.pdf
[25] https://silicon-austria-labs.com/

CYBERSECURITY

Cybersecurity is a topic shared by the ICT Work Programme and the Work Programme of Societal Challenge 7 "Secure Societies". In ICT, the topic has been open once in 2014 and then again, with 4 subtopics, in 2018. Austrian financial gain from the ICT-2014 call has been very high (10% of the available budget), whereas in 2018 the success was negligible (1% of the available budget).

The Austrian participation in H2020 is supported by the involvement of the *Bundeskanzleramt Cyber Sicherheit Plattform*[26] in the cPPP Cybersecurity (ECSO).

HIGH PERFORMANCE COMPUTING

With the creation of the Joint Undertaking EuroHPC[27] the topic attracted a lot of attention on European and national level. Topics so far spread across three Work Programmes (ICT LEIT, FET and Research Infrastructures) are pooled within the JU and complemented by procurement actions to increase the capacity of the strategic resource HPC in Europe. Another political item is to make Europe less dependent on HPC technologies and solutions from other global regions. National funding shall be put into the JU by participating Member States to increase the possible impact of the initiative.

The Austrian HPC community is meeting once a year ("Austrian HPC Meeting"), but there is no thematic platform or other official cooperation mechanism in place so far. Nevertheless, the Austrian HPC related research community is relatively strong in areas like software optimisation for massive parallel computing, but there is a distinctive lack of HPC solution providers in industry. Existing companies tend to be comparatively small and usually are spin-offs of scientific institutions, with a strong RTD character. Austria also lacks a "HPC Center of Competence for SMEs" as supported within the Research Infrastructures programme in Horizon 2020.

Overall, HPC has been a quite small topic in the Austrian ICT landscape (e.g. 5 successful Austrian participations in 4 projects with a total funding for Austria of 2.3 M€), but with a potential to grow substantially, subject to Austrian national support.

NEXT GENERATION INTERNET

NGI as a topic has received noteworthy amounts of funding only recently, with two minor "preparatory" actions in 2014 and 2017. The Austrian financial gain from the latest call in 2018 corresponds in the range of the Austrian contribution to the Horizon 2020 budget.

The topic is loosely connected to the former *Future Internet* Initiative with less emphasis on technological development and a strong focus on social sciences/behavioural aspects, usability and similar areas. It integrates communities

[26] https://www.bundeskanzleramt.gv.at/cyber-sicherheit-plattform
[27] http://eurohpc.eu/

that have been active in areas intersecting ICT and Social Sciences before (like the former "CAPS – Collective Awareness Platforms for Sociality" topics).

Austrian actors are working on the conceptual discussion on the Future Internet and its societal implications. Discussion fora are organized e.g. by IoT Austria[28] and AIT[29].

In Austria, the innovation ministry BMVIT introduced via FFG a complementary funding line within the national programme *ICT of the Future*[30].

QUANTUM TECHNOLOGIES

The quite new *FET Flagship Quantum Technologies* is one of the greatest successes of Austria in H2020 in large-scale initiatives: Austrian organisations participate in every second project financed out of Horizon 2020 in this field and coordinate two of them. The Austrian participation in the Quantum Technologies Flagship is supported heavily on a national basis as well (e.g. FFG program for Quantum Technologies QFTE, and the Austrian support to the Quantum Technologies ERA-Net QuantERA[31]).

DIGITAL PLATFORMS AND DIGITAL INNOVATION HUBS

In April 2016, the Commission issued a communication outlining its strategy for allowing the European Union to fully seize the opportunities offered by digitisation across industrial and services sectors. To that end, the focus area has been mainly implemented with the two following types of activities:

- Cross-sectorial and integrated **digital platforms** and **large-scale pilots** for experimentation and co-creation with users.
- **Digital innovation hubs**, which provide easy access to the latest digital innovations and experimentation facilities to potential users.

As regards Digital Platforms and Pilots, Austria has already some national strategies and initiatives in place that are in this context[32]:

- "Industrie 4.0 Österreich"[33]: launched in 2015 by the Ministry for Transport, Innovation and Technology (BMVIT), aiming at securing and creating highly innovative industrial production and boost quality employment, thus strengthening Austria's future competitiveness
- "Produktion der Zukunft"[34]: an independent funding program installed by BMVIT, that promotes national and translational cooperative research and development projects

[28] http://www.iot-austria.at/ngi
[29] https://ngi.ait.ac.at
[30] https://www.ffg.at/en/ictofthefuture
[31] https://www.ffg.at/quantenforschung-und-technologie
[32] https://ec.europa.eu/futurium/en/system/files/ged/austria_211117.pdf
[33] http://plattformindustrie40.at
[34] https://www.bmvit.gv.at/innovation/produktion/produktion_der_zukunft.html

– "Digital Roadmap for Austria"[35]: published in 2017, foreseeing strategies and topics on security, R&I, infrastructure, economy, mobility, health, work 4.0, education and inclusion.

The second type of activities regard Digital Innovation Hubs, which are expected to be one-stop shops to help companies with their digitization efforts with expertise and infrastructure. Member States and regions are expected to play a key role in establishing DIHs that support the digital transformation of industry in their regions. The role of the European Commission is to link them up in a strong pan-European network of DIHs. For this, the European Commission is investing 100mn EUR per year from 2016 to 2020[36]. To help DIHs to effectively collaborate and network, the European Commission launched the European catalogue of DIHs[37], a repository that includes the active organisations which are operating as hubs in each Member State. As shown in

Figure 11, there are currently 4 Austrian active organisations listed as DIH (all of them located in Styria) and 4 in preparation, with only one member of an EU granted consortium in 2014 and a recently granted partner in 2018 for an upcoming DIH in Robotics.

In order to promote more participation in this area on a regional base, the Austrian Ministry for Digital and Economic Affairs opened also a national funding program for DIH in 2018[38].

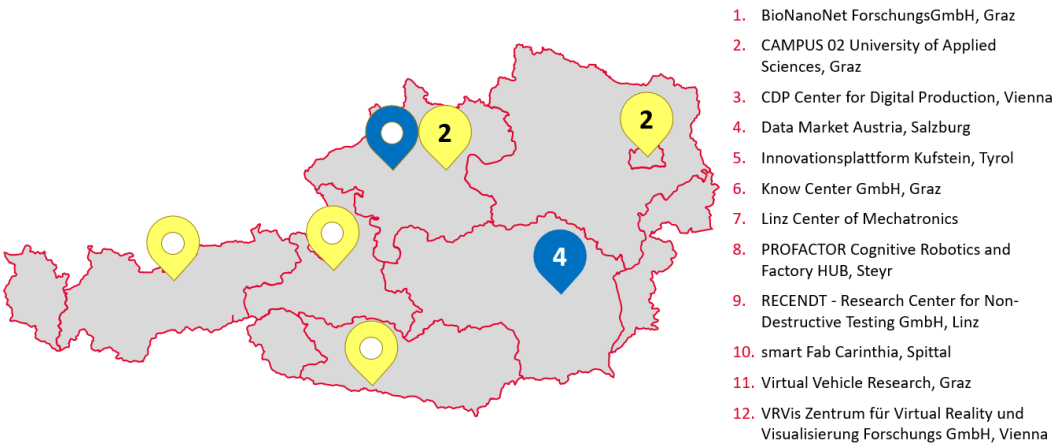

Figure 11: Digital Innovation Hubs as listed in the EU catalogue (yellow - in preparation; blue - operational)

5.2 Outlook into the next programming period (2021+)

In June 2018, the European Commission published the proposal for the next Research Framework Programme, "Establishing Horizon Europe – the framework Programme

[35] https://www.digitalroadmap.gv.at
[36] https://ec.europa.eu/digital-single-market/en/digital-innovation-hubs
[37] http://s3platform.jrc.ec.europa.eu/digital-innovation-hubs-tool
[38] https://www.ffg.at/dih

for Research and Innovation"[39], which defines the long-term Union budget for research and innovation (2021-2027). In this chapter we try to appraise how the area of "Digital", that replaces the ICT nomenclature will be implemented in the future.

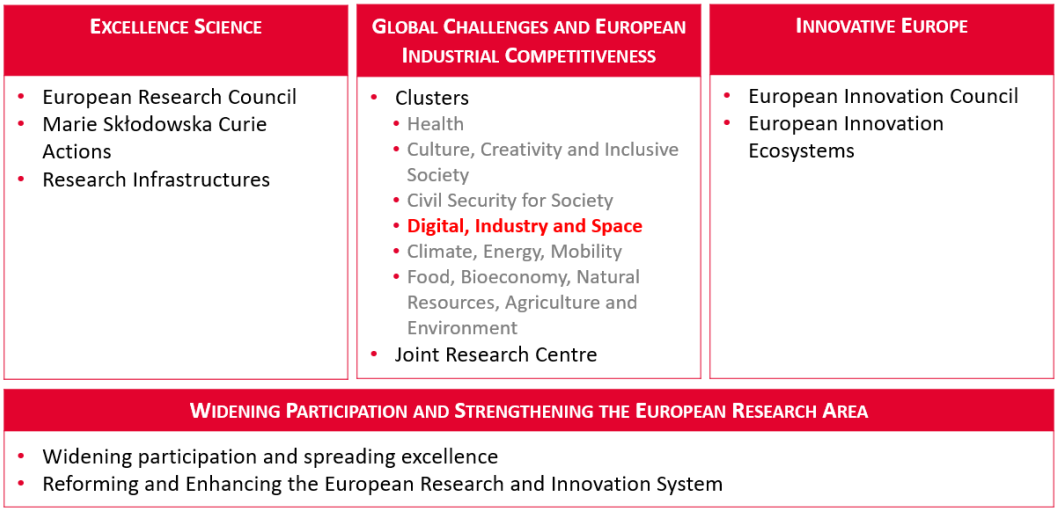

Figure 12: Structure of the future Research and Innovation Programme as proposed by the European Commission (source: European Commission 9870/19 + ADD 1)

In the Horizon Europe porgramme structure, the topics of H2020 are going to be reorganized in three new pillars. In particular, pillar 2 will address global callenges topics in 6 clusters. Among them, the backbone for digital innvation will be the **Cluster 3 "Digital, Industry and Space**". Rather than addressing specific sectors or actors, the investments in this pillar aim at systemic changes for our society and economy. Thus the ICT community has to change its mindset by co-designing research projects with a lot of different actors like end-users, innovators, businesses, educators, citizens and civil society organisations in the future. In addition to addressing global challenges, activities in the clusters will also develop and apply digital, key enabling and emerging technologies, which have been significantly expanded with the latest KET topics (see following table 5). These aspectes are particularly relevant to Austria, where there is important to see as Austria has a strong community in specific KET areas like e.g. micro- and nanoelectronics.

[39] https://ec.europa.eu/commission/sites/beta-political/files/budget-may2018-horizon-europe-regulation_en.pdf

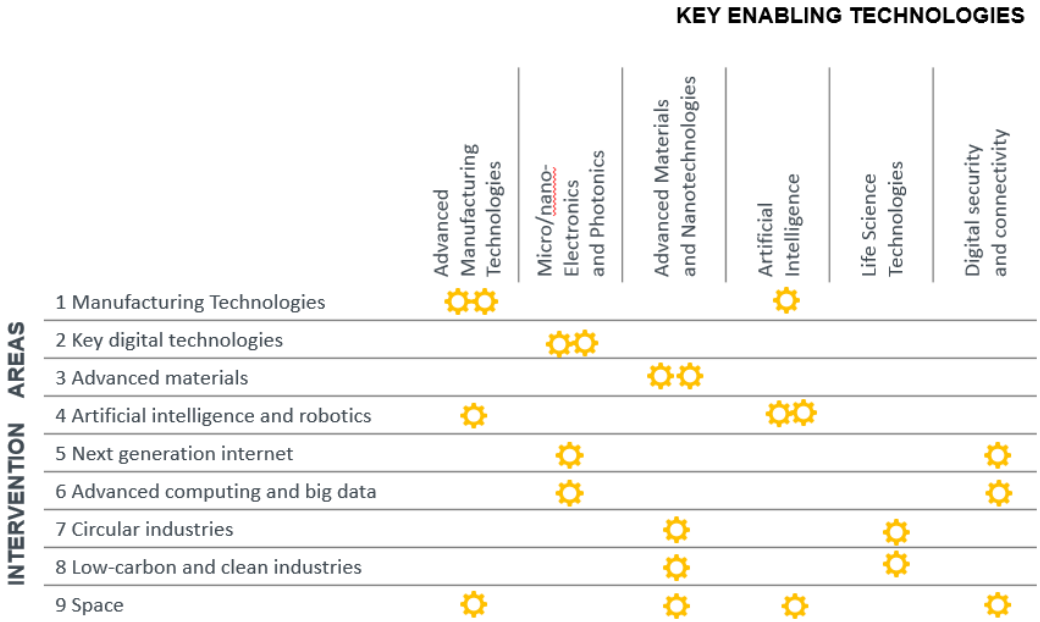

Table 5: EC presentation on "ICT in Horizon Europe" (source: European Commission)

The combination of the Digital (ICT) and Industry areas brings in the same single cluster a very broad spectrum of technologies. On one hand, depending on the future comitologie, such mergecan lead to the situation that programme commitee members will have less influence on the programm as there will be not proper time for indepth discussion. On the other hand, this cluster will have the advantage to develop technological and industrial capacities for industrial competitiveness and brings together the technologies that enable other clusters to tackle global challenges.

Moreover, future applicants have to be aware that this cluster is covering a lot of areas that are touching European social and ethical values, e.g. a human-centric internet, AI and citizens, protecting privacy, the need of new skills, the human element in manufacturing.

Another relevant change is that activities from the H2020 FET Programme (FET Flagships and FET Proactive) will be transferred to activities of the European Research Council (Pillar 3). A positive consequence of this shift is that hat - following actual negotiations – in cluster 3 there will be a unified intervention area that allows the development of **new enabling technologies** and support research themes from an early exploratory stage to demonstrations in pilot applications.

Concerning activities "outside" the framework programme, the EC proposed so far **Partnership areas**, where different single Partnerships shall contribute to the area objectives. For the ICT topic one area on "Advancing key digital and enabling technologies and their use, including novel technologies such as Artificial Intelligence and quantum technologies" is foreseen. This area is tailor made for a continuation of JU ECSEL, but also for e.g. a possible new partnership on artificial intelligence.

The complexity will rise starting from 2021, when new funding programmes will be launched, namely the **Digital Europe Programme (DEP), the Connecting Europe Facility** (CEF) and the and MEDIA (Creative Europe) programme. Although the

European Commission assures complementarity and no overlaps between Horizon Europe and those Programms, we see an increased need for specific support services to guide the Austrian community to the right programme.

To be well prepared on the Horizon Europe intervention areas and its topics, we linked the upcoming areas with existing Austrian specific support measures (no bottom up Programmes like the *General Programmes* of FFG are included in this analysis), to identify areas where a need for action arises. Table 6 shows this initial analysis to be complemented with additional input with more information available along Horizon Europe negotiations.

Horizon Europe		Austria			
Cluster "Digital"	**Topic**	**Policy actors**	**Governance & multipliers (incl. COMET centres of excellence)**	**Strategies**	**Support Measures**
Key digital technologies	nano-electronics	BMVIT	ECSEL Austria, Silicon Austria, Silicon Alps		ICT of the Future - ECSEL
	sensing technologies, part of the Internet of Things	BMVIT	ECSEL Austria, IoT Austria		ICT of the Future - ECSEL
	alternative technologies (neuromorphic computing, quantum computing etc.)	BMVIT BMBWF		QuantERA; QFTE; "Strategic analysis of Ways to stronger ones Industrialization of the results of Austrian quantum research (BMVIT)"	Quantum research and technologies
	computing architectures and low-power processors	BMVIT	ECSEL Austria, Silicon Austria, Silicon Alps		ICT of the Future - ECSEL
	computing hardware designs, security-protection	BMVIT BKA	Cyber Sicherheit Plattform, SBA Research		ICT of the Future - ECSEL
	photonics	BMVIT	Photonics Austria		Production of the Future - EUREKA
	system engineering technologies for autonomous systems	BMVIT	Plattform 4.0		ICT of the Future Production of the Future Mobility of the feature
	software technologies	BMVIT BMDW	Software Competence Center Hagenberg, VRVIS		ICT of the Future
	emerging technologies	BMVIT BMBWF			
Artificial Intelligence & Robotics	enabling AI technologies such as machine learning	BMVIT BMDW BKA	Österreichischer Rat für Robotik und künstliche Intelligenz	Artificial Intelligence Mission Austria 2030	
	user-driven AI technologies	BMVIT BMDW BKA	Österreichischer Rat für Robotik und künstliche Intelligenz	Artificial Intelligence Mission Austria 2030	
	research competences for AI	BMVIT BMDW BKA	Österreichischer Rat für Robotik und künstliche Intelligenz	Artificial Intelligence Mission Austria 2030	
	technologies for open AI platforms like algorithms	BMVIT BMDW BKA	Österreichischer Rat für Robotik und künstliche Intelligenz	Artificial Intelligence Mission Austria 2030	
	robotics	BMVIT	GMAR - Gesellschaft für Mess-, Automatisierungs- und Robotertechnik Österreichischer Rat für Robotik und künstliche Intelligenz	Report "Die Zukunft Österreichs mit Robotik und Künstlicher Intelligenz positiv gestalten"	
Next Generation Internet	Future network & service infrastructures (incl. beyond 5G), IoT, distributed clouds, blockchains	BMVIT BMDW	IoT Austria, Austria Blockchain Center	5G Strategy Austrian Blockchain "9 Punkte Plan"	
	Human centric Internet applications (incl.trust and privacy), Multi-modal interaction, language independency, trustworthy media	BMVIT	IoT Austria		ICT of the Future
	Distributed processing and data analytics, incl. distributed ledger technologies, embedded AI	BMVIT	Know Center, Software Competence Center Hagenberg, Digital Intelligence Offensive	Study "Big Data in Austria"	ICT of the Future
Advanced computing & Big Data	high performance computing	BMVIT BMBWF	Know Center		ICT of the Future - HPC (in preparation)
	big data	BMVIT	Know Center	Study "Big Data in Austria"	ICT of the Future
	reduced carbon footprint of ICT				

Table 6: Comparison of Horizon Europe "digital" intervention areas and topics vs. Austrian policy actors, thematic governance and specific support measures and analysis

The analysis can serve as a basis for a broader discussion with Austrian policy makers. A first interpretation can be that there are areas like "technologies for autonomous systems" or HPC which clearly need more concerted political attention.

6 OBSERVATIONS

Our analysis shows an overall Austrian performance indicators, although slightly decreasing from the higher success in FP7 (e.g., secured funds were 3.5% of the available budge in FP7, while it is 3.3% in H2020 until now). Although there are some *high performing areas*, where Austrian organisations play a key role in Europe, there are areas of interest where different actors might want to take a closer look and develop specific activities.

To facilitate this process, we provide a number of strategic and thematic observations below.

STRATEGIC OBSERVATIONS

IMPROVE NATIONAL COORDINATION OF THE DIGITAL TOPIC

- Upcoming "hot" topics on European level like Artificial Intelligence show that a concerted *modus operandi* among the responsible policy actors for *ICT digital* in Austria is needed. While on a "policy" level established structures exist (CDOs), on a "strategic/operational" level (e.g. ministerial departments), such regular, structured communications would be helpful. An informal group of representatives from departments could meet periodically, update each other and react fast on specific requests from the EC. As needed, specific experts from the community could be invited to give input. Persons should be nominated and communication channels should be put in place to allow a fast and concerted reactions.

STREAMLINE THE ALIGNMENT OF NATIONAL TO EUROPEAN INITIATIVES

- To maximise the impact of national measures, the alignment with European initiatives of similar nature is essential. Activities in the past shall be seen as "lessons learnt" for the future (e.g. the publication of the national Digital Innovation Hubs call overlapping with a similar European call for proposals will not lead to the intended "head start" for Austrian proposers in the current European DIH initiative). A very positive example is the early start of several national activities for Quantum technologies (starting with QuantERA; leading to national funding programme QFTE).

OPTIMISE PREPARATION OF THE AUSTRIAN ICT COMMUNITY ON HORIZON EUROPE

- There is no longer a separate programme for ICT, but ICT being part of one of the clusters on Digital, Industry and Space. Therefore, there needs to be a consistent

guidance given to the ICT constituency on where the ICT topics are to be found in the new structure of HE, as the term ICT will disappear. This is necessary because over the last 20 years of EU Research, Development and Innovation Programmes a constituency has been built of companies and research organisations that understands themselves as being in the *ICT domain*. This constituency needs to be provided with practical information and guidance on the new Research and Innovation funding opportunities in Horizon Europe. FFG has to adjust its services to this new framework conditions and support the needed change of mind-set within the Austrian community.

SUPPORT THE AUSTRIAN ICT STAKEHOLDERS NAVIGATING THE COMPLEX EUROPEAN PROGRAMME LANDSCAPE WITH 'DIGITAL' CONTENT

- Raising the awareness that Digital research, innovation and deployment will be addressed in several programmes (e.g. Horizon Europe, DEP, CEF, Creative Europe and European Defence Fund) will be a major effort in the transition phase from H2020 to the next programming period. FFG and the responsible policy stakeholders need to develop appropriate support formats to address that.

THEMATIC OBSERVATIONS

CONTINUE SUPPORT TO THE CYBER-PHYSICAL SYSTEMS COMMUNITY AND COMPLEMENTARITY WITH EUROPEAN TOPICS

- The Austrian community is well connected nationally and internationally and is performing well on the operational and strategic level. BMVIT and FFG have to continue to support this thematic spearhead of the Austrian ICT research and innovation ecosystem.
- The "Silicon Austria" initiative should aim towards early compatibility or complementarity with "European topics" and mechanisms and should strive to be a main "entry point" for the international community to the Austrian science and industry in CPS. This has to be well communicated to the respective target groups. According efforts have to be supported by BMVIT and FFG. Newly established actors in this area like "Silicon Austria" or "Pilotfabrik", shall be supported by FFG to align their research core areas with European policies.

STRENGTHEN THE AUSTRIAN PHOTONICS COMMUNITY

- The support by BMVIT for the well engaged and connected Austrian photonics community should be continued and further engagement at high levels in Europe (Photonics21) encouraged.
- The late drop of received funding for Austrian organisations has to be analysed further and discussed by FFG and BMVIT with the community via the Photonics Austria platform. In case the lower engagement was not intended, awareness and support measures should be stepped up by FFG. If needed, BMVIT in its role

as Delegate for ICT in Horizon 2020 should ask the European Commission to support appropriate actions in relevant areas for photonics in future funding programmes.

REINFORCE THE ROBOTICS COMMUNITY

- There are several opportunities coming up in the next years (e.g. call on Robotics DIH) where a national coordinated process is needed. GMAR is the platform responsible for synchronizing the Austrian Robotics community.
- BMVIT therefore should ask of GMAR to kick off and implement according next steps for an Austrian involvement.
- Underwhelming success rates have to be increased through quality enhancing measures (with respect to the submitted proposals). To this end, FFG and BMVIT shall raise the awareness of support options (e.g. FFG trainings and proposal services) within the robotics community in Austria.

SUPPORT A NEW APPROACH TO BIG DATA RESEARCH AND INNOVATION IN AUSTRIA

- The absence of an active Austrian thematic platform restricts participation in strategic processes and fora to very view organisations. Now with the reorganisation and establishment of the "Date Intelligence Offensive (DIO), a renewed approach to pooling the national communities' contribution and implement strategic steps towards European big data initiatives should be possible. Such activities should be initiated by the DIO stakeholders with support by BMVIT and FFG, taking into account lessons learnt from *Digital Networked Data*, but also from other thematic platforms.

IMPROVE AND CONSOLIDATE HIGH PERFORMANCE COMPUTING SECTOR IN AUSTRIA

- Austria is in danger of falling behind EU standards in terms of available HPC capacity and HPC usage from the industrial sectors. Since HPC is labelled a "strategic resource" for a country/region, capacity building on one hand and strengthening of industrial usage on the other hand should be looked into. A coordination process between the academic oriented and the industry oriented policy side is needed to achieve considerable progress.
- To consolidate the Austrian HPC sector and to build a supporting base for decision making on policy level (e.g. with respect to the Austrian contribution to the JU EuroHPC), a thematic group of interested parties has been recently established by BMVIT and BMBWF. Institutionalising this group would support the HPC sector timely and properly.
- H2020 supports "HPC Centres of Competence for SMEs" and no Austrian participation has been funded so far. To support promising SMEs with nationally available HPC capacities, such a centre should be established – ideally taking into account already available resources (e.g. in the academic sector).

7 ANNEX – RECOMMENDATIONS FROM THE "ERA THEMENDOSSIER IKT" (2015)

Empfehlung ICT Themendossier 2015	Maßnahmen Vorschlag	Erledigung
In der ICT LEIT-Ausschreibung von Horizon 2020 gab es bemerkenswert hohe Überzeichnungsraten mit bis zu 21-facher Überzeichnung. Das bedeutet: Die Nachfrage ist weit höher als das Angebot. Um das Verhältnis wieder ins Lot zu bringen, muss die österreichische IKT-Delegation im Programmausschuss eine stärkere Fokussierung bzw. Präzisierung der ausgeschriebenen Themen verlangen.	Einbringen in ICTC als Vorbereitung WP 18-20	° Eingebracht bei der Besprechung WP 17-18 in ICTC ° Teil der AT Stellungnahme zu WP 18-20
66% der IKT-Budgets in Horizon 2020 werden thematisch durch vertraglich geregelte „Öffentlich-Private Partnerschaften" (PPPs) dominiert. Oftmals entsteht der Eindruck, dass diese PPPs „closed clubs" der dahinterstehenden Akteure sind. Hier ist es die Aufgabe der österreichischen Delegation, darauf zu achten, Transparenz und Offenheit der PPPs einzufordern und die aktive Teilnahme der österreichischen Community zu fördern.	Einbringen in ICTC - bereits eingebracht für PPP Cybersecurity	° Eingebracht bei der Besprechung WP 17-18 in ICTC ° Teil der AT Stellungnahme zu WP 18-21
Ausschreibungsartige „Budgetvergaben über Projekte" (über Competitive Calls) kommen öfter zum Einsatz als bisher (z.B. in den Bereichen „Future Internet" oder „Robotics"). Die Erfahrungen haben gezeigt, dass hier die Transparenz nicht immer ausreichend gegeben ist. Der Pro-grammausschuss verliert dadurch neben dem Überblick außerdem die Möglichkeit, Projektförderungen in Frage zu stellen.	Idealist ICTC	Diskutiert im ICTC; EC hat neue Guidelines für Cascading Grant erstellt; alle Calls sind am Participant Portal; Forderung auch über das NCP Netzwerk gestellt
Die Themen TOLAE und OLED (ICT 29) sind trotz vorhandenem Potenzial und Erfolgen im 7. Rahmenprogramm unter Horizon 2020 bisher nicht genutzt worden. Hier bedarf es einer Abklärung der Ursachen zwischen BMVIT/FFG und der Photonics Austria Plattform.	FFG bei Photonics Plattform meeting	FFG bei Photonics Austria Plattform Treffen anwesend und aktuelle Calls vorgestellt. (Ergebnis 2 erfolgreiche Beteiligungen von 2)
Strategische FFG-Beratungs- und Betreuungsinstrumente auf Organisationsebene (z.B. bei strategischen Keyplayern) haben sich bewährt, um den Herausforderungen der komplexen europäischen FTI-Landschaft am IKT-Sektor zu begegnen. Eine Ausweitung dieser Services ist geplant.	Strategiegespräche ERA Dialoge C3	Gespräche zentralen Organisationen sind umgesetzt;

„Impact description“ und „exploitation plan“ waren die beiden häufigsten Kritikpunkte bei den Anträgen der österreichischen IKT KoordinatorInnen. Bei mehr als 40% der österreichisch geführten Anträge wurde „ground-breaking/beyond state-of-the-art“, sowie die Darstellung des Ansatzes (credibility of approach) negativ erwähnt. Hierauf wird die FFG bei der Beratung und bei Trainings verstärkt ihr Augenmerk richten.	ICT Antragsteller Webinar zu Impact	Webinar am 2.3. 2016 durchgeführt und laufend in Beratungen neues Webinar am 11.1.2017 zu Impact
EIT Digital hat Bestrebungen, durch jährlich stattfindende „Idea Challenges“ für Start-ups weitere Organisationen aus bisher nicht repräsentierten Ländern einzubinden. Für die Zukunft ist eine verstärkte Bewerbung durch die FFG bei geeigneten österreichischen Organisationen vorgesehen.	Adäquate Bewerbung der "Idea Challenge"	Bewerbung im Mai 2015 im IKT NL, FFG NL und 3x am Web sowie an die WKO-Kreativwirtschaft gesendet
Es zeigt sich, dass die vorausschauende Abstimmung nationaler IKT-Programme auf europäische Trends positive Auswirkungen auf die Performance österreichischer Organisationen in europäischen Programmen hat. Diese Mechanik einer nationalen Ausrichtung soll durch Programmeigentümer und -Abwickler soll beibehalten bzw. ausgeweitet werden (z.B. bei schlecht besetzte Themen wie 5G Network Infrastructures und Future Internet).	Abstimmung mit BMVIT	Abstimmung mit BMVIT erfolgt (Dez. 2015) verstärkter Bemühungen zu 5G (Workshop) und FI (neuer NCP für NGI)
Den Bereichen Future Internet und 5G Network Infrastructures gilt es in Zukunft verstärkt Aufmerksamkeit zu schenken, da sie auf europäischer Ebene prioritär (cPPP) und hoch dotiert (389,5 Mio. Euro) sind. Einige Akteure in Österreich haben das Potenzial, in Nischen mitzuwirken. Gerade die wissenschaftliche Community in Österreich ist zu diesem Thema zu wenig vernetzt. Das BMVIT bzw. die FFG sollen hier gezielt die Community unterstützen (z.B. durch Aufbau einer nationalen Plattform oder Vernetzungsveranstaltungen).	5G WS organisiert mit AIT Fragebogen an die Community verschickt FI Veranstaltungen beworben	Webinar mit Fokus auf 5G im Juni 2016 gehalten Bewerbung von NIG kontinuierlich
Weiters sollen Kapazitäten für künftige EU Themensetzungen (z.B. High Performance Computing - HPC) aufgebaut werden (aus SRAs, Arbeitsprogramme 2016/17). Dafür sollten gezielt weitere Stärkefelder durch flexible nationale Ausschreibungen entwickelt und so auf die europäischen Ausschreibungen vorbereitet werden.	Abstimmung mit BMVIT erfolgt	FFG bei Photonics Austria Plattform anwesend und aktuelle Calls vorgestellt. (Ergebnis 2 erfolgreiche Beteiligungen von 2)
Wenn in bestimmten Themenfeldern (wie beispielsweise RFID und NFC) eine Marktreife erreicht ist, die Technologien in Produkten bereits eingesetzt werden und die	AWS Workshop FFG	Workshop wurde verschoben

Weiterentwicklungen im Allgemeinen inkrementell sind, müssen sich nationale Innovationsprogramme entsprechend ausrichten.		
Die Kooperation der FFG mit den Forschungsservicestellen an den Universitäten funktioniert im IKT-Bereich noch nicht zufriedenstellend. EinreicherInnen scheinen nur punktuell mit Detailfragen an die IKT-ExpertInnen weitergeleitet zu werden. Es gibt noch immer eine signifikante Zahl von allgemeinen Fragestellungen.	ERA Dialog, Informationspaket für FoS, Dialoge mit FoS der für IKT zentralen FoS; Dekangespräche;	IKT in den relevantesten ERA-Dialogen präsenter dargestellt; erstes IKT Infopaket an FoS geschickt; gezielte Nachfragen bei FoS zu ICT-Einreichungen zeigen teilweise erste Wirkungen (Kontakt zu Einreichenden hergestellt)

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All data in this dossier are based on data provided by the European Commission and by FFG. FFG points out that the results refer to a specific point in time (where no other indication is given, this is 04/2018).