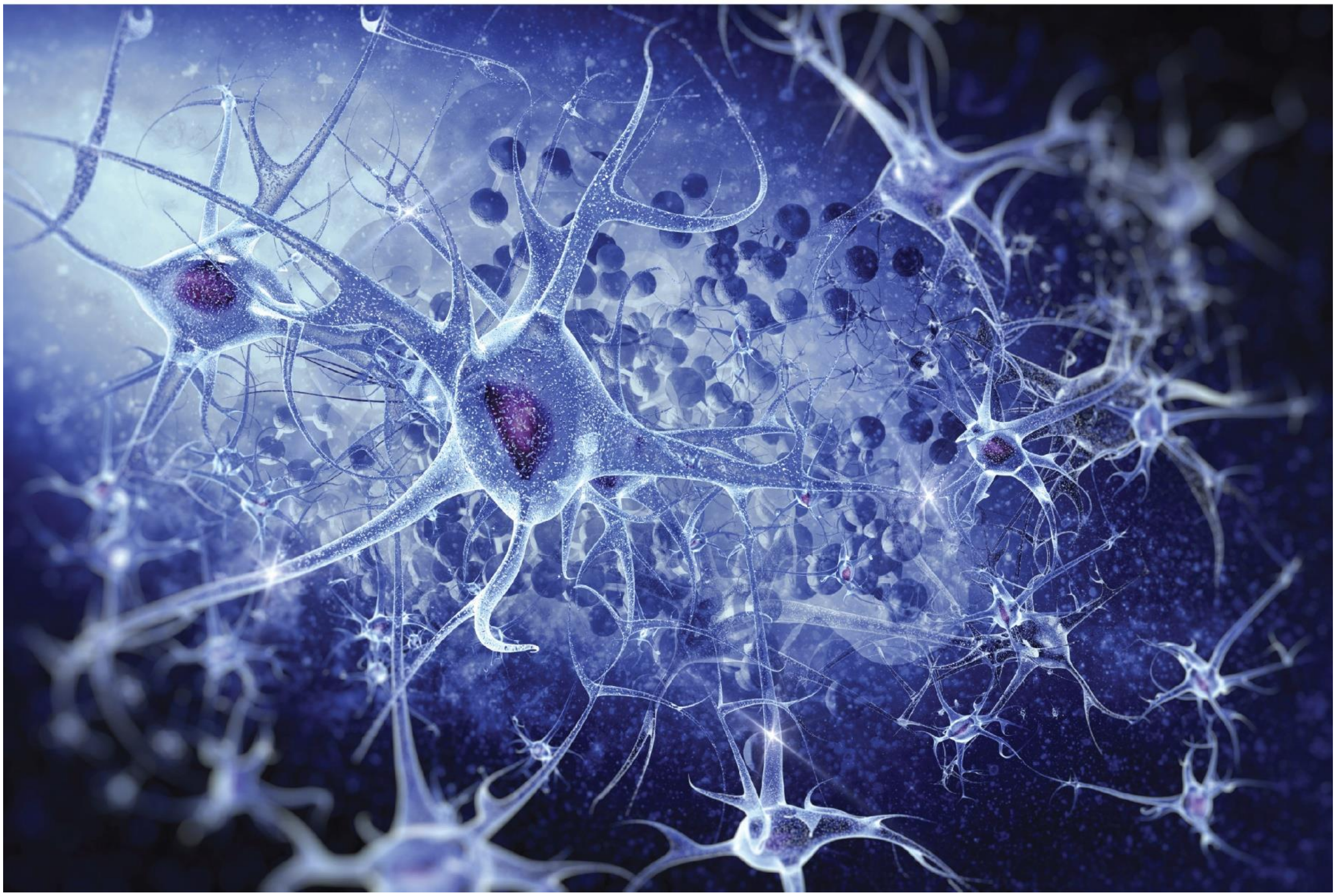
REPORT ON ACADEMIA-INDUSTRY COLLABORATION SUPPORT SCHEMES AND THEIR OPENNESS FOR INTERNATIONAL COOPERATION

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No 692468.



DELIVERABLE 4.1

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PREAMBLE

The US has a limited number of schemes that support projects abroad involving academia-industry cooperation. It has however schemes to support foreign researchers to conduct research activities in the United States (US) such as post doc opportunities. Regarding the situation at the European Union (EU) level, there are several programmes that support international cooperation, including foreign researchers mainly through EU supporting programmes.

The report focuses on showing support schemes that exist at the EU and US level. Support for academia-industry cooperation in the US happens at both the Federal and state level. In Europe, this cooperation happens at both the EU and Member States (MS) levels. In this sense, the report includes an overview through selected examples of the processes employed at the Federal and state levels from the US side and at the European Commission (EC) and MS levels that encourage academia-industry cooperation. Additionally, it is relevant to note that many US universities have their own programmes or processes for coordinating with industry.

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EXECUTIVE SUMMARY

This report is a product of the BILAT USA 4.0 project, funded by the European Union (EU), and started on the 1st of February 2016. BILAT USA 4.0 continues the activities started by the predecessor projects BILAT USA and BILAT USA 2.0 with the aim to enhance and develop Science, Technology, and Innovation (STI) partnerships between the United States (US) and the EU. A particular focus of the project activities is placed on increasing interactions between EU and US researchers and innovators, providing the support for the improvement of research and innovation framework conditions, conducting analyses that deliver a sound base for policy decision making, and on enhancing coordination and synergies between different European and US policies and programmes.

This report on academia-industry collaboration support schemes and their openness for international cooperation (Deliverable 4.1) aims to provide an assessment of the current academia-industry collaboration support schemes both in the EU and the US, assessing their openness for international cooperation and analysing good practices through several success stories. Subsequent to this report, the project team will organise two good practice workshops on academia-industry collaboration aiming to bring academia and industry actors from the EU and the US together to support international cooperation. The Report will be disseminated prior to the workshops and discussed with the participants.

The European Commission (EC), as the executive body of the EU proposes new legislation to the European Parliament and the Council of the EU, and it ensures Member States (MS) correctly apply EU law. The EC is composed of several Directorate-Generals (DGs). With regard to STI, the Directorate-General for Research and Innovation (DG RTD) has the most important role. Moreover, there are a number of distinct EU agencies that offer information or advice to the EU institutions, the MS and EU citizens also contribute extensively to the shaping and development of the European STI landscape by executing specific EU programmes under a target area (e.g. Innovation and Networks Executive Agency (INEA) or the Executive Agency for Small and Medium-sized Enterprises (EASME)). Furthermore, this report analyses the approach of academia-industry cooperation support schemes from selected EU MS (Germany, France, Portugal, Sweden and Czech Republic).

In the US system, national support schemes of various kinds are available through Federal departments, such as the Department of Defense (DoD), and independent Federal agencies, such as the National Science Foundation (NSF). However, the limited number of schemes that target academia-industry relations are only a part (often an incidental part) of a much larger research, development and innovation (RDI) effort. Furthermore, since the overall RDI effort in the US is now dominated by business spending, rather than Federal spending, the relationship between business and academia has been changing significantly. In addition, state and regional support schemes are analysed as these supplement funding provided at the Federal Government level, and represent a key feature of the US system. The two university cases outlined below highlight the independent, strategic and complex strategies pursued by major STI universities in the US. It is at the level of individual institutions where the key initiatives in academia-industry collaboration are developed and executed.

In order to assess the support schemes selected for the analysis, the project team conducted extensive desk research (literature and document analysis) and target interviews with 20 relevant programme owners (10 from the EC and EU MS and 10 from the US Federal Government and US States). From the European side, four programmes at the EC level and six programmes from five different relevant MS countries at the EU level are analysed with the aim of providing a geographical coverage of several regions in Europe (north, south and east Europe). From the US side, programmes from five departments and agencies at the US Federal level

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(in total 17 programmes) and four programmes at the state and university level are analysed.

Through the analysis developed on the academia-industry programmes, the project team compared and contrasted the characteristics of both regions taking into account each programme’s funding structure, application process and international dimension. From this analysis, the project team concluded that the funding structures at the EU level are mostly provided by the DG RTD and it is highly variable at the MS level; while in the US, Federal funding is dispersed across several agencies and a wider range of sources are available at the state level. In terms of the application process, the project team considered it to be proportionate at the EC and MS levels; while in the US this is characterized by having a high number of pre-requisites that must be addressed beforehand. Regarding the success rate of applications (rate of proposals that are approved in comparison with the number submitted), the US tends to be higher than the EU. Moreover, the project team concluded that the international dimension of both regions is somewhat limited. In the EU, it is relevant to note that Horizon 2020 (H2020) financially supports the eligibility of several countries outside the EC, including the US (under certain requirements). At the MS level, it is more difficult to find relevant programmes that are open to US organisations. However, not all the MS programmes were analysed. In the US, there are some entities that provide relevant funding programmes for international cooperation at the Federal level, although there is no special effort to target EU partners. It is at the level of individual institutions in the US where the key initiatives in academia-industry collaboration are developed and executed.

Despite limitations of the collaboration outlined above, this comparative assessment allowed the project team to propose a set of opportunities for further international cooperation between the EU and US collaboration support schemes. The opportunities identified are linked to the alignment of thematic areas in both regions, which should lead to: more international cooperation between the regions in topics of mutual interest; development of opportunities that promote international openness in academia-industry participation (e.g. industry player from the US and an university from the EU), with direct eligibility of the participants; simplification of the application process, with explanatory guidelines and entities to support fulfilling the requirements; and more coordination between academia and industry in terms of Intellectual Property Rights (IPR), legal issues and differences in business practices, particularly between the EU and US. The description of opportunities for further improving international collaboration should be addressed by departments and agencies from both regions that promote academia-industry cooperation actions.

In addition to the comparative assessment, the project team provides three success stories as showcases of US Federal level, EC level and US-EU joint funding, based on specific criteria. The three cases were selected according to their international dimension and openness for participation, eligibility of the types of participants and the inclusion of initiatives that promote direct interactions between both regions. These success stories provide an insight on motivations, needs, outcomes and appreciation of the academia-industry collaboration at different levels.

The first success story focuses on the International Technology Alliance (ITA) in Network and Information Sciences (NIS) at the US Federal level. It provides an example of how the US Department of Defense and the United Kingdom (UK) Ministry of Defence (MoD) support collaboration among government, academia and industry, with a total budget of $92 million provided jointly by the UK Defence Science and Technology Laboratory and the US Army Research Laboratory over the course of the programme’s 10 years. The main aim of the programme is to produce fundamental advances in network and information sciences to enhance distributed, secure and flexible networks for information delivery and decision-making in future coalition operations. The NIS-ITA is considered to be an outstanding example of research collaboration, promoting dual-use applications of its research and technology to benefit commercial use.

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The second success story is related to the project "BIOactive implantable CApsule for PANcreatic islet immunosuppression free therapy" (BIOCAPAN). This project is funded under the EU H2020 programme call H2020-NMP-2014-two-stage. This is a good example of a project financed by the EC that aims at promoting innovative Good Manufacturing Practices (GMP)-grade cell-therapy product, to treat diabetes without insulin injections and immunosuppressant administration. The project involves a total of 9 partners from both the EU and US (receiving funding from the EU), including universities, research institutes and private companies.

The third success story concerns the Center for Visual & Decision Informatics (CVDI) that has received funding from industry members, the NSF and Tekes. The programme concentrated on activities that promote high-quality industry relevant research and direct technology transfer of ideas, research results and technology to the US industry.

Through the three success stories, this report identifies several good practices of efficient academia-industry cooperation between the EU and the US. The diversity of the partnership, including the presence of different relevant players, is considered to be of added value to the project's success and a common good practice. In addition, it is good practice to include the involvement of key industry players in the project consortium as a crucial instrument to guarantee efficient academia-industry cooperation and increase the chances of transferring research results to the market.

Both the EU and the US have an extensive range of academia-industry collaboration support schemes for the development of innovative projects. To some extent, these support schemes focus on international cooperation. However, further promotion of coordination actions between regions, in particular towards international openness, can be considered a key factor for further enhancing and developing the STI ecosystem. Furthermore, mechanisms for increasing incentives and overcoming IPR issues would benefit academia-industry projects and, therefore, promote new cooperation actions between EU and US innovation actors.

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1. INTRODUCTION

This report represents Deliverable 4.1: Report on academia-industry collaboration support schemes and their openness for international cooperation. The Deliverable is under Work Package (WP) 4: Engaging industry actors in transatlantic EU-US STI collaboration, Work Task (WT) 4.1. Enhancing international academia-industry collaboration. WP4 focuses on the intensification of international academia-industry cooperation and the support to transatlantic business internationalisation in RDI.

The Deliverable provides an assessment of the current academia-industry collaboration support schemes both in the EU and the US, reviewing their openness for international cooperation and analysing good practices through several success stories.

The Deliverable is developed using both desk research (literature and document analysis) and targeted interviews with 20 programme owners (10 from the EC and EU MS and 10 from the US Federal Government, US states and US universities)[1]. The analysis focuses on both EU and US Federal level and national / state level schemes. The detailed structure and methodology developed for this analysis is further presented in Section 2 of this report.

The Deliverable mainly targets programme owners, researchers, companies and industry representatives as well as other support actors such as clusters and relevant networks. The Deliverable will be able to provide the target group with information on international academia-industry cooperation and transatlantic business internationalisation actions, supporting research partnerships and teaming of research, innovation and business actors.

Following the publication of this deliverable, the project will organise two “good practice” workshops on academia-industry collaboration aiming to bring academia and industry actors from the EU and the US together to support international cooperation. The Report will be disseminated prior to the workshops and discussed with the participants. In addition, a policy-brief on international academia-industry collaboration will be produced for EU and US policy-makers based on the analysis developed under this deliverable.

Both the EU and the US have academia-industry collaboration support schemes. On the US-side, national support schemes aim to distribute funds across the US with little emphasis put on international cooperation. The EU is much more advanced regarding its openness for international cooperation and involvement of third-countries through direct or indirect support.

The subsequent section provides an overview of the methodology applied to place the results and recommendations in proper context. The results are presented based on quantitative and qualitative analysis, as well as additional desk research, thus justifying the recommendations and conclusions.

[1] Interview subjects were assured of anonymity, and the information collected is synthesized into the analysis without attribution.

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2. METHODOLOGY

The methodology employed under this deliverable is comprised of desk research (literature and document analysis) and complemented by target interviews with 20 programme owners (10 from the EC and EU MS and 10 from the US Federal government, US states and US universities). This analysis is aimed at identifying and assessing academia-industry collaboration support schemes with a particular attention on internationally oriented academia-industry collaboration support schemes. The project team has taken into account the relevant regional schemes and specific programmes, tools and incentives – especially those targeting collaboration between different states or regions, highlighting their international dimension wherever relevant. In this sense, the initial analysis is divided into the following sections:

- **US Academia-Industry Collaboration Support Schemes:** This section aims to describe the main academia-industry collaboration support schemes in the US, focusing on the Federal, state and university level. It provides an overview of the relevant Federal departments and agencies, as well as individual state programmes that support academia-industry cooperation.
- **EU Academia-Industry Collaboration Support Schemes:** This section aims to describe the main collaboration support schemes in the EU between academia and industry, focusing on both the EC and MS level. The approach is similar to the one used in the US support schemes, taking into consideration the different departments and agencies at the EC and MS levels.

The project team developed the following selection criteria for assessing a total of 20 support schemes (10 for the EU and 10 for the US) for academia-industry cooperation:

- Programmes that promote academia-industry collaboration.
- Programmes that range from different levels (national, regional, federal, state and university).
- Programmes that are publicly available.
- Programmes that are currently in operation.
- International openness is an advantage, particularly if the programme is accessible to US participants (for European programmes) or to EU participants (for US programmes).

The selected EU and US academia-industry programmes were analysed taking into consideration four forms of engagement: research support, knowledge transfer, cooperative research, and technology transfer. Research support entails the contribution of money, equipment, and facilities by industrial firms to universities. Knowledge transfer emphasizes personal communications, interactive education, and personnel exchanges. Cooperative research involves close interaction between members of the university and firms to fulfil formal research agreements and objectives. Technology transfer translates a university's basic research into applied processes and products for a company. The framework for selection includes only programmes that focus largely or wholly on academia-industry collaboration. Programmes in which this element is only a secondary consideration are much less likely to be a source of best practice. These programmes are categorized along two dimensions: breadth of sectoral engagement, and depth of engagement. The framework for analysis developed for the EU and US is presented in Section 3 and Section 4 of the present document.

Furthermore, and according to the inputs received from the interviewees and the literature analysis developed for each support

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scheme, the project team provides a detailed assessment of the collaboration programmes according to the following structure:

Table 1 – Cooperation programmes' assessment structure

Brief overview of the programme	• Programme owner: organisation, department in charge, type • Objectives • Main thematic fields, research fields • Date of creation
Quantitative overview	• Programme budget, and budget allocated to academia-industry collaboration in particular • Number of academia-industry projects supported each year and average budget / budgetary range
Types of industry-academia collaboration supported	Key requirements of the programme in terms of: • Nature of exchanges (knowledge, technology, infrastructures…) • Size / scale of projects supported
Beneficiaries of the programme	Key requirements in terms of: • Beneficiaries (type) • Composition of the partnership (number of partners, incl. per type) • Stage of business operation (for industries)
Instruments and process to support industry-academia collaboration	Actions implemented by the programme: • Which actions: selection and funding, partner search, support through coaching and training (topics), mobility support. • Selection of projects (process: e.g. existence of a jury, composition) • Expected results, impacts and evaluation
International dimension	• Openness to international cooperation • Geographical coverage • Conditions for openness • Frequency of such cases (and if relevant, budget dedicated to it)

In addition, the project team conducted a good practice analysis of relevant academia-industry collaboration programmes. Success stories are identified through available impact studies, supporting literature, interviews and networks of involved partners to get insights on motivations, needs, roles, outcomes and appreciation of the academia-industry collaboration schemes. These success stories focus on the following aspects: objectives, fields and partners involved; motivation and needs; support scheme and how it was chosen – characteristics; results/ outcomes of the cooperation; and appreciation of the academia-industry collaboration. Furthermore, the following terminology is used in this deliverable:

- Funding agencies/entities: sources and organisations that provide funding programmes (e.g. DG Research and Innovation).
- Funding programmes/schemes: specific funding opportunities within each funding agency/entity (e.g. Horizon 2020).
- Programme owners: main contacts responsible within each funding programme/scheme.

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3. US ACADEMIA-INDUSTRY COLLABORATION SUPPORT SCHEMES

In the US system, national support schemes of various kinds are available through independent Federal agencies, such as the National Science Foundation (NSF), and other Federal departments and agencies. However, the limited number of schemes that target academia-industry relations are only a small part of a much larger research and development effort. Furthermore, since the overall Research, Development and Innovation (RDI) effort in the US is currently dominated by business spending, rather than Federal spending, the relationship between business and academia has undergone several important changes. Although academic researchers still receive a great deal of support from the Federal government, they are increasingly inclined to seek support from business. At the same time, the importance of academic output to business R&D efforts has declined. It is important to recognise that this relationship is navigated, for the most part, at the level of the individual academic institution and business. Support is provided mostly on the commercialization side, but companies still fund basic academic research. Federal and state programmes and initiatives may facilitate or accelerate these connections, but firms or universities almost always initiate collaborations.

US state support schemes in general have a narrower focus on a state's assets and priorities, and direct funding provided from the Federal sources accordingly. Universities are central to the way funding is directed, whatever its source, and they enjoy an important level of discretion in collaboration development.

A broad-brush statement about the RDI efforts of the Federal government would characterize spending on basic science as occurring through universities and research institutes (and some large corporations) and spending on development (especially military development) as occurring through business. Federal spending, outside the NSF, tends to be mission driven (organisations formed and/or managed to accomplish a certain objective).

However, the Federal government has more recently placed a greater emphasis on academia-industry collaboration due to the increased interest in technology transfer. While government leaders continue to believe in the value of basic science investments, they also increasingly believe that these investments are validated by successful technology transfer and by converting research into viable commercial applications. To accomplish this, universities, national laboratories and other research institutes often have to work with businesses or business start-ups as the end user. This in turn has led to a growth of Federal programmes that foster academia-industry collaboration.

The Federal programmes examined in detail below foster academia-industry collaboration not as an end in itself, but as a mechanism for meeting mission-based goals. These programmes generally support a broad variety of academia-industry interactions, except in the case of the National Institutes of Health (NIH), whose programmes have a narrower focus on the development of treatments for human disease, and the Small Business Technology Transfer (STTR) programme, which has a specific focus on technology transfer and commercialization. If successful, this should increase productivity in the private sector, but that broad goal is emphasised less than the narrower purpose of validating basic and applied science investments.

State governments (and institutions found at the state level such as universities) and even some regions also support activities that foster academia and industry collaboration. In these cases - for example where a state government provides support to a business to engage with a university in technology transfer or technology development - the goals are clearly focused on economic development, including growth and development in terms of income and employment of the region or state in question. It could be said that this too is a "mission" based approach, with business-academia collaboration just one piece – encouraged as possible

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and as necessary – of an overall strategy.

One important characteristic of state and regional efforts is that they very often privilege locally represented economic sectors or clusters. This generally is not true at the Federal level. The Federal government targets life sciences or energy, but for political reasons its spending is broadly distributed and mission focused and does not target the general success of a particular business cluster. In contrast, as is shown in the cases discussed below, states and regions do not oppose actively supporting academia-industry collaboration in specific areas.

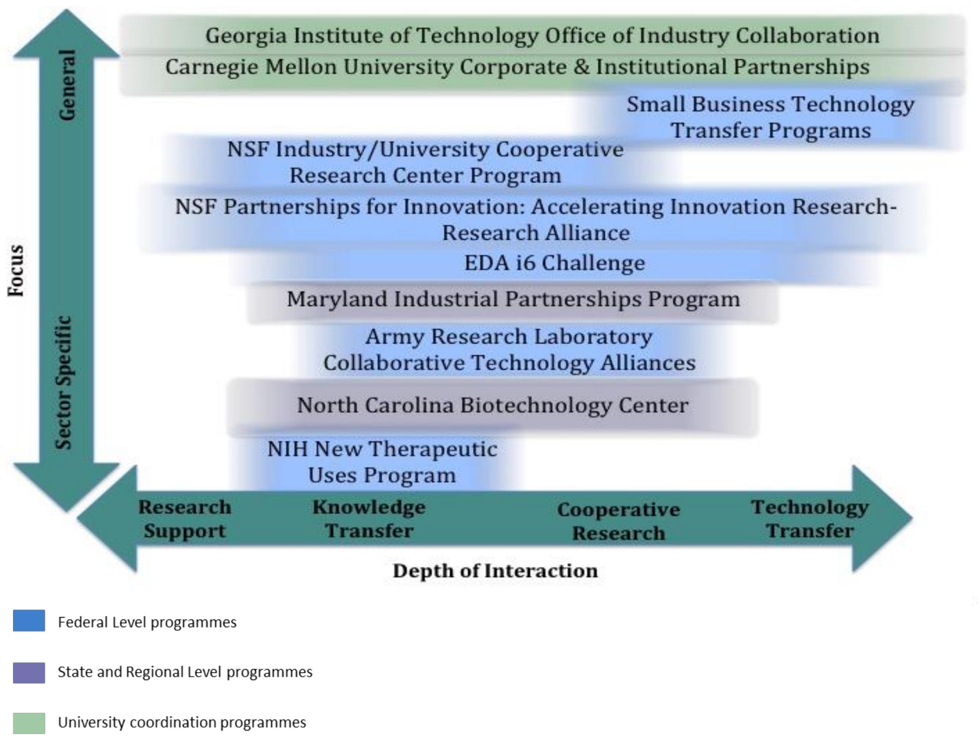

Figure 1 – US programmes selected for the analysis

3.1. US Academia-Industry Collaboration Support Schemes at the Federal Level

3.1.1. Overview

The most important departments and agencies, in terms of level of effort, in US Federal STI spending are the Department of Defense (DoD), National Institutes of Health (NIH), Department of Energy (DoE), National Science Foundation (NSF), and the National Aeronautics and Space Administration (NASA). Of these five, only the NSF has a broad mandate, largely focused on basic science. The others, as their names indicate, are mission driven agencies. In addition to providing STI funding to universities and businesses, they also have internal laboratories, in some cases with very substantial basic and applied research capabilities. The research these departments and agencies support is intended to advance a particular mission. While universities and businesses may work together on many of these projects, this is incidental to the mission, and not a deliberate objective.

All these agencies are under increasing pressure to support the transition to end use of some of the technologies that they fund. For example, the DoE has a large network of National Laboratories established initially with important national security and basic science purposes. All of these labs, to a greater or lesser extent, are currently seeking increased partnerships with business. The

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circumstances are different to those prevailing at universities, but the models they have adopted are potentially instructive. For example, the Manufacturing Demonstration Facility (MDF) at Oakridge National Laboratory (ORNL) is an arrangement in which the constraints imposed by the laboratory's national security mission are balanced with the need to give outside partners from business access to the technology and talent in the lab. The link to the DoE mission in this case derives from the energy efficiency gains made available through advanced manufacturing.

The experience of universities, on the other hand, is framed by the impact of the Bayh-Dole Act in governing the use of Intellectual Property (IP)[2]. For example, the NSF funds research on a disciplinary basis. It also funds capabilities, such as the Engineering Research Centers (ERC) at major universities where businesses enter into partnerships with universities. Decisions over the technologies produced by NSF funding are made at the level of the institution, which retain the IP rights as a result of the Act, or in limited cases may provide the IP rights to businesses through pre-arranged agreements as seen in the ERC programme. Universities can license their IP with exclusive rights to commercialisation to a specific company. Most Federal programmes that foster academia and business links do not single out one sector over another. It is regional factors that often determine academia-industry relations, because each university is at liberty to realize the value of the IP they retain from government-funded research in the way they see fit. For example, a university located in a region home to an automotive manufacturing cluster may align its research around this sector's needs, and mobilize whatever Federal funding it can to that end.

Two other agencies, the Economic Development Administration (EDA) and the Small Business Administration (SBA) do not have access to the same levels of funding that the departments and agencies discussed above enjoy, but they do have programmes that foster relations between academia and business, with a special emphasis on small businesses and start-ups. Although the funding levels are modest, the design of these kinds of programmes emphasizes the role played by a university or business in programmatic efforts that build regional innovation ecosystems. For that reason, one of these programmes is analysed in greater detail below.

In addition, it is relevant to refer the Small Business Innovation Research (SBIR) that supports RDI and financing of new technology. This programme has supported small businesses that aim to engage in Federal RDI activities with potential commercialization. In this sense, SBIR encourages small businesses to explore technologic solutions, high-tech innovation and entrepreneurial spirit.

3.1.2. Department of Defense

The DoD is the largest Federal department in the US and has a well-established mission. For that reason, connections that arise between academic researchers and business (i.e. defence contractors) are idiosyncratic, and generally not part of deliberate policy. However, DoD has begun to understand that many key technologies that could enhance its ability to perform its mission are developed outside DoD laboratories and university labs. This development has increased its interest in directly fostering academia-industry collaboration, but not in an agency-wide way. DoD's relations with business are still characterised by specification-based development of systems and products through a network of contracts and sub-contracts.

3.1.2.1. Collaborative Technology Alliances (CTAs)[3]

To support the rapid transition of innovative technologies to the war fighter, the US Army Research Laboratory (ARL) created

[2] The Bayh-Dole Act governs the U.S. system of technology transfer. It enables universities to retain title to inventions and take the lead in patenting and licensing groundbreaking discoveries.

[3] http://www.arl.army.mil/www/default.cfm?page=93

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collaborative research partnerships among Army laboratories and centres, private industry, and academia called Collaborative Technology Alliances (CTAs)[4]. The distinct approach to research that each alliance member brings to the project is a key element to the success of the CTAs: academia brings cutting-edge innovation; industrial partners leverage existing research results for transition and to deal with technology bottlenecks; and ARL keeps the programme oriented toward solving the Army's complex technological problems[5]. The CTAs enable ARL to bring together world-class research and development talent to focus on Army-specific technology objectives for application to Army needs.

Initially, ARL served as a programme manager, developing programme topics based on the needs of the DoD. Consortia formed on their own to propose projects in response to programme announcements. The original CTAs could last up to 10 years and were intended to facilitate exchange between the partners—scientists from ARL would spend time at universities and companies and scientists from universities and companies would spend time at ARL. The CTAs were evaluated based on how many joint publications they produced and how many people were exchanged between the partners. Successful consortia included experts in the specific technology areas and managers who could integrate the work.

Following the completion of the first round of CTAs, ARL modified the application process. The domain expertise and the integrator positions were bid separately, and a greater emphasis was placed on collaboration and cooperation. To ensure the technologies developed through the CTAs could be transitioned to the army, ARL included both individuals who were familiar with how the technology would be deployed and individuals who understood the basic research in the consortia. Now ARL establishes CTAs by first identifying the academic partner, then choosing the integrator, and finally picking the industry partner. This matchmaking between the university and business partners by the ARL represents an unusual degree of top-down direction.

CTA projects are now funded at $5-8 million per year for 5-10 years, and usually involve a consortium of industrial research laboratories and universities that team together to solve research problems in a specific domain[6]. The alliances establish core research activities through cooperative agreements and use task order contracts to facilitate technology transition. The consortia are expected to develop their own IP agreements in which any IP developed within consortia is shared and all technology brought into the consortia by individual members is acknowledged. The government retains its standard rights to the technology. During the five-year base programme, CTAs are expected to demonstrate the viability of their technology. In the optional five-year renewal period, CTAs narrow their focus and begin development work. The CTAs are expected to deliver technology to the army at Technology Readiness Level 3 (TRL3). The CTAs also provide opportunities for postdocs, grad students, and undergraduates to spend time working at ARL. The CTAs are evaluated based on metrics that reflect the goals of each partner including: the number of publications and presentations developed by academics; the extent of collaboration among partners; how many people are exchanged between sites and for how long; technology transitions to the Army; and industrial development. In the future, ARL intends to complete bibliometric analysis to show how publications from all the CTAs have influenced the research community and laid the groundwork for future studies. ARL currently supports four active CTAs: Micro Autonomous Systems and Technology (MAST) CTA; Network Science (NS) CTA; Robotics CTA; and Cognition and Neuroergonomics (CAN) CTA[7].

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[4] Current CTAs. (2011, March). Retrieved December 8, 2016, from https://www.arl.army.mil/www/default.cfm?page=389

[5] Committee on Review of Army Research Laboratory Programs for Historically Black Colleges and Universities and Minority Institutions, Army Research Laboratory Technical Assessment Board, & Laboratory Assessments Board. (2014). Appendix B: Summary Description of Army Research Laboratory Collaborative Research Programs. In *Review of Army Research Laboratory Programs for Historically Black Colleges and Universities and Minority Institutions*. Retrieved December 8, 2016, from https://www.nap.edu/read/18963/chapter/11

[6] Partnership Methods & Opportunities. (2010, September 1). Retrieved December 8, 2016, from https://www.arl.army.mil/www/default.cfm?page=9#ctas

[7] Current CTAs. (2011, March 1). Retrieved December 8, 2016, from https://www.arl.army.mil/www/default.cfm?page=389

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ARL has found that industry is often a poor project integrator. Companies often expect CTA research to connect to current product lines rather than viewing the CTA as a chance to develop a new product. When bringing industry into a CTA, ARL is now careful in how it structures the alliance. ARL looks for industry partners that are willing to make investments in the future and that understand they should not expect to realize a return-on-investment for several years.

***International Technology Alliance*[8]**

The ARL International Technology Alliance (ITA) is a collaborative partnership among ARL, the United Kingdom's Ministry of Defence (UK MoD), and a consortium of industries and universities in the US and UK. The programme focuses on solving scientific problems in the context of coalition operations, and limits its research explorations to fundamental research that can be published in academic forums.

Launched in May 2006, ARL and the UK MoD jointly funded the first ITA, which aimed to advance the fields of Network and Information Science (NIS). The 10-year research project addressed research issues relating to network theory; security across a system of systems; sensor information processing and delivery; and distributed coalition planning and decision making[9]. The NIS-ITA illustrated how the application of synergistic combinations of these technical areas to network centric warfare and network enabling capabilities could support a range of military missions including humanitarian support, peacekeeping, and full combat operations in any kind of terrain, but especially in complex and urban terrain. The alliance created a critical mass of private sector and government scientists and engineers focused on solving the military's technology challenges in network centric warfare for both countries, as well as supporting and stimulating dual-use applications of this research and technology to benefit commercial use. The NIS-ITA programme received $92 million over the course of its lifetime. IBM Research in the US and IBM Emerging Technology in the UK led the consortium of academia and industrial partners throughout the programme's 10 years of highly successful collaborative research involving over 850 researchers from 160 organisations spanning 25 countries[10]. A team consisting of one technical leader each from ARL, UK MoD, IBM Research, and IBM Emerging Technology led the alliance. Additionally, a panel of four scientists, one each from ARL, UK MoD, an academic member of the alliance, and an industrial member of the alliance, led each of the technical research areas throughout the project.

In October 2016, ARL and the UK Defence Science and Technology Laboratory (DSTL) awarded a second ITA. The 10-year, $80 million programme will again feature an IBM-led academia and industry consortium. This basic research programme focuses on Distributed Analytics and Information Science (DAIS). The goal of DAIS-ITA is to define the scientific theory required to build a "distributed coalition intelligence" to help rapidly formed teams make best use of human and machine processing capabilities when they are distributed at the edge of the network. The alliance will address research issues relating to dynamic adaptation of secure, resilient context-aware information systems; distributed integration and exploitation of coalition data and information across heterogeneous information infrastructures; and derivation of situational understanding of complex situations by human users synergistically supported by machines[11].

[8] http://nis-ita.org/

[9] Networks and Information Science International Technology Alliance (ITA). (2011, February 16). Retrieved December 8, 2016, from https://www.arl.army.mil/www/default.cfm?page=77

[10] Braines, D. (2016, April 21). Network and Information Sciences International Technology Alliance. Retrieved December 8, 2016, from http://blog.ibmjstart.net/2016/04/21/2876-2/

[11] Braines, D. (2016, October 26). World-class research alliance in Distributed Analytics and Information Science. Retrieved December 8, 2016, from http://blog.ibmjstart.net/2016/10/26/world-class-research-alliance-distributed-analytics-information-science/

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3.1.3. National Science Foundation

The NSF is in an independent Federal agency that aims to "to promote the progress of science; to advance the national health, prosperity, and welfare; and to secure the national defense". The NSF is the main source (outside the life sciences) of basic science research funding in the US. Its mission permeates all of its programmes, and although NSF has a greatly increased interest in applied research and technology transition, it still constitutes a very small portion of its activities. For that reason, funding programmes directed at business remains a small piece of its portfolio. Nevertheless, some programmes are deliberate in fostering academia-industry collaboration.

3.1.3.1. Grant Opportunities for Academic Liaison with Industry[12]

The Grant Opportunities for Academic Liaison with Industry (GOALI) programme promotes university-industry partnerships through funding of projects and fellowships/traineeships in support of a broad range of industry-university linkages. GOALI funds allow faculty, postdoctoral fellows, and students to conduct research and gain experience in industrial settings; industrial scientists and engineers to bring industry's perspective and integrative skills to academia; and interdisciplinary university-industry teams to conduct research projects, in which the industry research participant provides critical research expertise, without which the likelihood for success of the project would be diminished. GOALI aims to fund research that exceeds what industry normally supports. To do this, GOALI targets high-risk/high-gain research with a focus on fundamental research, new approaches to solving generic problems, development of innovative collaborative industry-university educational programmes, and direct transfer of new knowledge between academia and industry. Regarding international cooperation, GOALI encourages the development of these coordinated actions as long as there is a clear added value to the project. Proposals for international cooperation are evaluated according to the value brought at the domestic level. In this sense, international collaborations that strengthen proposed project activities are encouraged, specifically when there is an opportunity for coordinated funding with scientists and students from foreign institutions who will add value to a particular project.

3.1.3.2. Engineering Research Centers[13]

NSF launched the Engineering Research Center (ERC) programme in 1985 to develop a new interdisciplinary culture in engineering research and education in partnership with industry in order to strengthen US competitiveness and to educate new generations of engineers capable of integrating fundamental knowledge across disciplines into advanced systems-level technology. Under the programme, ERCs receive 10-years of support from NSF, during which time they are expected to create an innovative, inclusive culture in engineering that cultivates new ideas and pursues engineering research that achieves significant science, technology, and societal outcomes. ERCs are also required to support research experiences for undergraduates and teachers, and pre-college summer research programmes.

NSF currently supports approximately 20 ERCs covering the areas of advanced manufacturing; biotechnology and health care; energy, sustainability and infrastructure; and microelectronics, sensing and information technology. There have been three generations of ERCs, each specifically designed to meet the current engineering demands of the US. The third, most recent generation of ERCs is expected to develop and globally commercialize novel engineering solutions. This generation of ERCs must have between one and four domestic university partners, at least one of which serves underrepresented groups, and between one

[12] https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=504699
[13] http://erc-assoc.org

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and three non-domestic partners, almost always businesses. These ERCs are also required to partner with domestic pre-college institutions, such as local middle and high schools, and have industry/practitioner members that pay fees to use ERC resources, such as businesses and hospitals. ERCs receive up to $3.25 million in funding during the first year. Funding then increases by $250,000 per year until the maximum of $4 million is reached. Eighty-five percent of ERCs are self-sustaining at the end of their 10-years of NSF support. ERCs are allowed to receive supplemental funding from corporate partners. Awardees are selected through an open, competitive selection process.

ERCs are some of the most prominent platforms at STI institutions that deliberately foster academia-industry collaboration. However, while ERCs focus on some specific technical areas by agreement with NSF in the initial proposal (for example, in materials or bio-engineering) and may name specific business partners as part of the initial proposal, those relationships are mutually agreed upon among the partners, and not subject to matchmaking or any other input from NSF. Academia-industry partnerships in this model are an entirely bottom-up process, even if substantial financial support comes from Federal funding. In this sense, this can be an opportunity for collaboration since US entities may benefit from European engineering talents.

3.1.3.3. Innovation Corps Teams[14]

The NSF Innovation Corps Teams (I-Corps Teams) programme aims to accelerate the development of new technologies, products and processes that arise from NSF-funded basic research projects by teaching NSF-funded faculty, students and other researchers to understand innovation and entrepreneurship. The programme identifies NSF-funded researchers whose work has the potential to attract subsequent third party funding and provides them with mentoring and funding to accelerate the translation of knowledge into emerging products and services. The I-Corps Teams programme offers entrepreneurship training to participants through a targeted curriculum that combines experience and guidance from established entrepreneurs.

The six-month I-Corps Teams grant provides selected I-Corps teams (an I-Corps team includes the Principal Investigator, the Entrepreneurial Lead, and the I-Corps Mentor) to participate in an entrepreneurial immersion course. I-Corps Teams training helps project teams determine the readiness of technology developed by NSF-funded projects for transition. I-Corps Teams project outcomes include a clear go or no go decision regarding viability of products and services; a transition plan for projects that will move forward, and a technology demonstration for potential partners. I-Corps Teams are invited to apply to the programme following a pre-application phase. The I-Corps Team awardees are chosen through a competitive selection process.

3.1.3.4. Industry/University Cooperative Research Centers[15]

The NSF created the Industry-University Cooperative Research Centers (IUCRC) programme to catalyse long-term partnerships among industry, academia, and government. IUCRCs contribute to the nation's research infrastructure base, enhance the intellectual capacity of the engineering and scientific workforce through the integration of research and education, and facilitate technology transfer. The IUCRC programme leverages NSF funds through industry support to back graduate students performing industrially relevant pre-competitive research; expands the innovation capacity of US competitive workforce through partnerships between industries and universities; and encourages the US research enterprise to remain competitive through active engagement with academic and industrial leaders throughout the world. Each IUCRC pursues a specific line of research of mutual interest to all members of the centre; NSF does not invest in centres that overlap with the research foci of existing IUCRCs. NSF prefers to fund

[14] https://www.nsf.gov/news/special_reports/i-corps/teams.jsp
[15] https://www.nsf.gov/funding/pgm_summ.jsp?pims_id=5501

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multi-university over single-university IUCRCs because the multi-site centres expand the research base and increase the likelihood and frequency of interactions among centre participants.

All accredited American universities and two and four-year colleges are eligible for the IUCRC programme. A significant portion of the centre's financial support is expected to come from industrial, state, and other funds. The first stage in IUCRC formation involves the successful completion of an IUCRC planning grant. Upon successful completion of the planning grant, an institution can submit an application to join an existing or create a new centre. New IUCRCs spend their first five years in Phase I. This initial period of support allows for the development of a strong partnership between the academic researchers and interested industrial and government parties. As the centre grows, it is likely to have increased opportunities for funding from additional firms, other federal agencies and laboratories, and state and local governments. After five years, sites within centres that continue to meet the IUCRC programme requirements may request Phase II support. This five-year period of support allows centres to continue to grow, and to leverage and diversify their memberships and research portfolio. After ten years, sites within centres may apply for Phase III support. The five-year Phase III awards are provided for centres that demonstrate significant impact on industry research as measured through robust and sustained membership, student impact, annual reports, site visits, and adherence to IUCRC requirements. NSF expects IUCRCs to be fully supported by private and public partners after fifteen years.

Institutions applying to become a constituent site of an existing IUCRC must join the programme at the current phase of the centre. A site can only join a centre if it meets all the minimum requirements of the current phase. New constituent site awards are limited to the remaining duration of the Phase of the IUCRC. Throughout Phases I-III, NSF plays a supporting role in the development and evolution of the centre, providing a framework for membership and operations as well as feedback derived from extensive centre experience and evaluation. As appropriate, IUCRCs may engage in international collaborations to advance their goals within the global context.

3.1.3.5. Materials Research Science and Engineering Centers[16]

The NSF created the Materials Research Science and Engineering Centers (MRSECs) in 1994 to support materials research infrastructure and education in the US. MRSECs can be located at a single institution or involve multiple institutions in partnership. The centres promote active collaboration between universities and other sectors, including industry, national laboratories, and international institutions. Collectively, MRSECs form a national network of university-based centres in materials research, education, and facilities. The centres feature extensive experimental and computational facilities, which are generally accessible to outside users.

The six-year awards provide annual funding for MRSECs ranging from $1.5 to $3.5 million, depending on the overall scope of the research programme. MRSECs are expected to encompass two to three interdisciplinary research groups (IRGs). Each IRG typically involves 6 to 10 faculty members addressing a major topic or area in which sustained support for interactive effort by participants of complementary backgrounds, skills, and knowledge is critical to progress. MRSECs are encouraged to apply a fraction of their funds to support of seed projects that respond to promising new research opportunities. The largest portion of MRSEC funding is directed toward support of undergraduate and graduate students and postdoctoral researchers to help train and educate the future workforce. Additionally, MRSECs conduct a broad range of education and outreach activities involving K-12 students and public education through collaborations with museums and other public institutions. Competitions are held every three years and are

[16] http://mrsec.org/

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open to all US academic institutions. To preserve balance in the nation's materials research portfolio, NSF seeks proposals that address fundamental, timely and complex materials problems that are intellectually challenging, important to society, and that belong to or broaden the current MRSEC portfolio. NSF currently supports 21 MRSECs.

With this programme the emphasis is on interdisciplinary work, supported by the substantial infrastructure required for cutting edge materials science. There is an important role for business, but including business is incidental, if desirable, to the overall purpose of advanced research. The programme actively supports efforts to establish research collaborations and academia activities at the international levels.

3.1.3.6. Partnerships for Innovation: Accelerating Innovation Research-Research Alliance[17]

The NSF Partnerships for Innovation: Accelerating Innovation Research-Research Alliance (PFI: AIR-RA) programme was created to aid the movement of academic research discoveries into the marketplace. The programme leveraged NSF investments in research alliances to accelerate the translation and transfer of research discoveries into competitive technologies and commercial realities, promote the development or extension of the academic-based innovation ecosystem around an NSF-funded research consortium, and enhance the knowledge and practice of innovation in faculty and students. The programme aimed to create partnerships and collaborations among government, academia, and other public and private entities that contributed to the development of strong local and regional economies.

The PFI: AIR-RA programme created collaborations that offered cost-effective, timely, and risk-reduced approaches for potential investors to participate in the research and development of new products, processes, systems or services with high commercial impact. The involvement of third-party investors was essential to accelerate the innovations towards commercialisation. The programme required a partnership between an NSF-funded consortium and two or more separate additional entities. NSF encouraged the participation of three or more entities in order to build the necessary relationships required to develop and sustain a viable innovation ecosystem. At least one of the entities had to be a third-party investor and at least one had to be a research partner. PFI: AIR-RA awards provided up to $800,000 for 36 months. The total award, however, could not exceed the total committed co-funding from the third-party investor(s). The third-party investment could be cash, liquid assets, or tangible financial instruments. Up to 25% of the third-party investment could be intangible assets. In as much as successful exits often require a business to license, buy or invest in technology or a technology-based start-up, this programme had an indirect impact on academia-industry relations, but only as part of the goal of accelerating technology development.

3.1.3.7. Partnerships for Innovation: Building Innovation Capacity[18]

The NSF created the Partnerships for Innovation: Building Innovation Capacity (PFI: BIC) programme to support academia-industry partnerships that advance, adapt and integrate technology into a specified, human-centred smart service system. These partnership projects can originate from any knowledge domain or application area, but they must be focused on work in the translational, pre-commercialisation space and build on novel fundamental research with the objective of creating or transforming a "smart(er)" service system that has the potential for significant social and economic impact. In this programme, NSF places a heavy emphasis on the quality, composition, participation and contributions of the partners.

The PFI: BIC programme funds research partnerships working on projects in the translational phase and NSF expects the teams to

[17] https://www.nsf.gov/eng/iip/pfi/air-ra.jsp
[18] https://www.nsf.gov/pubs/2015/nsf15610/nsf15610.htm

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be aware of the state of the art and the competitive landscape. However, NSF does not require PFI: BIC awardees to have a clear path to commercialisation because these translational research projects still require additional work to integrate the technology into a service system enabling it to identify, learn, adapt, and make decisions.

NSF expects partnership activities to drive sustained innovation, such as the sharing of knowledge in a cross-organisational and interdisciplinary context, and the targeted allocation of resources, including capital, time, and facilities. PFI: BIC awardees must develop and follow a highly collaborative research plan in which primary industrial partner(s) as well as of any other partners participate with the academic partner throughout the life of the award. The research plan must also demonstrate how engineered system design and integration; computing, sensing, and information technologies; and human factors, behavioural sciences, and cognitive engineering will be integrated into the project.

PFI: BIC awards are up to $1 million total distributed over three years. The partnerships must include at least one university-based interdisciplinary academic research team and one US-based industry partner of any size with commercial revenues that include sales, services, or licensing and experience with bringing a product, process, service or system to the marketplace. Academic-industrial partnerships are required as part of this programme, although the focus is resolutely on pre-commercial technology development, which narrows the extent to which institution and business collaborate.

3.1.4. National Institutes of Health

The NIH is the largest source of multidisciplinary funding for biomedical research in the world. The NIH aims at promoting fundamental knowledge to enhance overall human health. An agency of the US Department of Health and Human Services consisting of 27 separate Institutes and Centres, NIH's $31.3 billion budget in fiscal year 2016 supported approximately 35,000 research grants and contracts and more than 300,000 researchers at over 2,500 universities, medical schools, and other research institutions located in every US state and in countries around the world. This funding also supported NIH's large intramural research programme, which includes the NIH Clinical Centre, the largest hospital in the world solely dedicated to clinical research, and is comprised of approximately 1,200 principle investigators and 6,000 trainees ranging from high school students to postdoctoral and clinical fellows. About 83 percent of the 2016 funding was distributed to the extramural community and another 11 percent of the funds sustained the intramural programme's basic and clinical research and training activities. The other six percent provided support for agency leadership, research management, and facilities maintenance and improvements.

NIH's primary role in the biomedical research enterprise is to provide funding for research projects, develop research infrastructure, and train the scientific workforce. In this role, NIH strives to fund a strong, diverse portfolio of biomedical research, flexible enough to capitalize on scientific opportunities and to respond to urgent public health needs as they arise. NIH supports innovative biomedical and behavioural research that advances medical science and improves health while stimulating economic growth. Due to its large public investment and strong infrastructure, NIH is an important component of the biomedical research enterprise. As a result, NIH has the ability to convene key players from academia, industry, regulatory bodies, and around the world to address challenges and advance research.

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3.1.4.1. New Therapeutic Uses Program[19]

The National Center for Advancing Translational Sciences (NCATS) created the New Therapeutic Uses Program to foster approaches that improve the translational research pipeline and accelerate the pace at which discoveries are turned into new preventions, treatments, and cures for human disease. As part of this programme, NCATS launched the NIH-Industry Partnerships initiative in May 2012 to foster collaboration between pharmaceutical companies and the biomedical research community on therapeutics development. This initiative uses innovative strategies to identify new uses for existing pharmaceutical assets that have already undergone significant research and development by industry, including safety testing in humans. The initiative matches academic researchers with pharmaceutical companies who have made select assets available for testing for new therapeutic uses. Through the initiative, companies provide researchers with access to the compounds and related data. By coordinating access for scientists nationwide to existing assets that have already cleared several key steps in the development process, this initiative seeks to accelerate the pace of therapeutics development and get new treatments to patients more quickly.

To enable access to pharmaceutical assets, NCATS developed template agreements with several pharmaceutical companies that streamline the legal and administrative process for partnering across multiple organisations. The agreements provide a roadmap for handling intellectual property used in or developed through the initiative. Under the agreements, participating industry partners retain the ownership of their compounds, while academic research partners own any intellectual property they discover through the research project with the right to publish the results of their work. The template agreements have reduced the time required to establish collaborations between industry and academia to as few as three months from the more typical nine months to one year. AstraZeneca; AbbVie (formerly Abbott); Bristol-Myers Squibb; Eli Lilly and Company; GlaxoSmithKline; Janssen Pharmaceutical Research & Development, L.L.C.; Pfizer; and Sanofi participated in the pilot phase, and AstraZeneca; Janssen Pharmaceutical Research & Development, L.L.C.; Pfizer; and Sanofi participated in the second phase of the initiative. The design of the template agreements represents a key practice for academia-industry relations in a space where IP is especially sensitive, and often an obstacle to collaboration. That, in combination with the idea of spinning technology back into the research setting from industry, underlines the novelty and value of the programme.

3.1.4.2. NIH Centers for Accelerated Innovations[20]

The National Heart, Lung, and Blood Institute (NHLBI) created the NIH Centers for Accelerated Innovations (NCAI) programme in September 2013 to accelerate the translation of NHLBI-supported scientific discoveries into commercial products that improve human health. NCAI is a public-private partnership that incorporates expertise and resources from the Federal government, academia, and the private sector. The $31.5 million, seven-year initiative aims to change the way discoveries with scientific and commercial potential are identified and developed.

Currently, the three NCAIs in Boston, Ohio, and California bring the capabilities of 14 high-impact research institutions to bear on gaps in the pipeline between scientific discovery and company formation. The centres receive a wide range of applications to develop devices, therapeutics, diagnostics, and tools to address a broad spectrum of heart, lung, blood, and sleep disorders. In order to help breakthrough innovations move rapidly into the commercialisation phase, the centres support proof-of-concept studies, educate academics on the technology development process and provide early access to the scientific and business

[19] https://ncats.nih.gov/funding/grantees
[20] https://ncai.nhlbi.nih.gov/ncai/

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expertise needed for commercialisation. The NCAIs provide early mentoring to innovators to help develop key business elements, which are critical for the commercial success of developed technologies, but often poorly understood by academic scientists. Key to success is upstream consideration of commercial and business issues coupled with industry-style project management with go/no-go milestones resulting in de-risked technologies with well-designed business cases primed for licensing or start-up company formation. Business collaboration is an important part of this programme, but the focus is on business-like practices among researchers, and the translation of technology.

3.1.4.3. Research Evaluation and Commercialisation Hubs[21]

Following the success of the NCAI programme, NIH decided to extend the NCAI model across the agency through the three-year, $9 million trans-NIH Research Evaluation and Commercialisation Hubs (REACH) programme. In March 2015, NIH added three Hubs in New York, Kentucky, and Minnesota to create a nationwide network of six NCAIs and REACHs. Together the Centers and Hubs aim to develop best practices for translating academic innovations into new drugs, devices, and diagnostics. To broaden the scope and impact of the NIH programme, each REACH location secured non-federal funding equal to or greater than its NIH award. The NHLBI administers REACH on behalf of the entire agency.

The NCAI and REACH network will enable the development of self-sustaining biomedical technology through the creation of ecosystems that encourage the conversion of laboratory discoveries into products and services and the dissemination of best practices for technology development to other agencies, institutions, and regions across the US. By moving innovative technologies into the private sector, the NCAI and REACH network will enhance the commercial outcomes of federally funded research, creating broad social benefits. International cooperation is limited within this programme.

3.1.5. Department of Commerce

The Department of Commerce (DoC) aims to create favourable conditions for economic growth and prosperity. DoC works with businesses, universities, communities, and the US workforce to promote job creation, economic growth, sustainable development, and improved standards of living for Americans. The Department administers its programmes through its 12 bureaus with offices located in all 50 states and US territories, as well as more than 80 countries worldwide. Through its programmes, DoC drives progress in five key areas: trade and investment, innovation, environment, data, and operational excellence[22].

DoC has a domestic focus, answering to a distributed set of domestic constituents. In particular, two agencies within the Department, the National Institute for Standards and Technology (NIST) and the EDA run programmes targeting regional and local economic growth. Their programmes provide services either indirectly, through grantees, or on a fee for service basis. The goal is small business and start-up success, and the economic growth and employment that result. Once again, while universities and businesses may collaborate through the programmes discussed below, these programmes are aimed at meeting the DoC's mission and do not have academia-industry collaboration as their main purpose or principal activity.

[21] https://grants.nih.gov/grants/guide/rfa-files/RFA-OD-14-005.html
[22] United States of America, Department of Commerce. (n.d.). *America Is Open for Business - Strategic Plan Fiscal Years 2014-2018*. Retrieved December 9, 2016, from http://www.osec.doc.gov/bmi/budget/DOCStrategicPlanV1 1_061815.pdf

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3.1.5.1. University Center Economic Development Program[23]

The University Center Economic Development Program provides competitive grants to institutions or consortia of higher education to establish University Centers. The Centres help the EDA leverage college and university assets, such as faculty, students, libraries, laboratories, facilities, computer systems, and specialized research, outreach, technology transfer, and commercialisation capabilities, to promote American innovation and strengthen regional economies[24]. The programme funds university-based initiatives focused on advancing regional commercialisation efforts, entrepreneurship, innovation, business expansion in regional innovation clusters, and a high-skilled regional workforce[25]. These Centres make university resources available to the economic development community in regions experiencing chronic or acute economic distress. They are required to devote the majority of their funding to addressing requests from communities and organisations located in economically distressed areas of their regions.

Currently there are 59 University Centers in 43 states and the Commonwealth of Puerto Rico offering a variety of specialized services to businesses, non-profits and local governments. The Centres offer a range of services tailored to their region's needs and each sponsoring institution's strengths. Many Centres specialize in particular industry sectors. The Centers conduct basic and applied research and provide technical assistance to public and private sector organisations with the goal of enhancing regional economic development. Centres help firms identify appropriate off-the-shelf technology to solve specific problems and recommend efficiencies in current operating procedures to improve production processes, reduce energy usage, and decrease the volume of raw materials lost in the production process[26]. They also offer business services, including market research, commercialisation assistance feasibility studies, geographic analysis, product development, strategic and financial planning, customized seminars and training, and management consultations. These services help businesses increase productivity, streamline operations, increase quality, and cut costs[27]. Some services are provided at no charge while others have varying fees.

3.1.5.2. Regional Innovation Strategy Program & i6 Challenge[28]

Regional innovation strategies are a keystone of the DoC's commitment to building globally competitive regions and the economic development capacities that regions need in order to flourish. As part of this strategy, funding is available through the i6 programme to support proof-of-concept and commercialisation assistance to innovators and entrepreneurs and for operational support for organisations that provide essential early-stage funding to start-ups. The i6 Challenge is a national competition that makes small, targeted investments to support start-up creation, innovation, and technology transfer. The programme's long-term goals are to expand jobs and economic development. The funding supports the development/expansion of new and existing proof-of-concept and commercialisation programmes and centres, which help innovators (scientists, entrepreneurs, and small businesses) fine tune and scale their innovations to bring new products and services to the market. About 50% of these centres are based at Universities.

Grantees receive up to $500,000 over a three-year period to provide a cluster of activities in support of regional innovation ecosystems. These activities include networking and marketing, mentoring and technical assistance, technology development, financing support, development of facilities and equipment, and workforce development. Through these centres, experts from the

[23] https://www.eda.gov/programs/university-centers/
[24] University Center Economic Development Program: Bringing Research to Work. (n.d.). Retrieved December 6, 2016, from https://www.eda.gov/tools/university-centers.htm
[25] University Center Economic Development Program. (n.d.). Retrieved December 6, 2016, from https://business.usa.gov/program/university-center-economic-development-program
[26] ibid.
[27] University Center Economic Development Program. (n.d.). Retrieved December 6, 2016, from https://business.usa.gov/program/university-center-economic-development-program
[28] https://www.eda.gov/oie/ris/

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private sector provide mentorship to entrepreneurs, expert guidance on the value and direction of technology development, and access to business networks for business services and marketing. This broad effort is deliberate, and targets the conditions for growth in which business can succeed. It does not single out, however, academia-industry collaboration. Such collaboration is often supported by the programme, but only as part of a portfolio of activities.

Results vary across grantees, but as an example, based on a roughly $500,000 investment in FY 2014, the New Orleans BioInnovation Center (NOBIC), in partnership with Louisiana State University and Tulane University, served 55 clients/beneficiaries, who reported creating 136 jobs, filing 115 patent applications, raising $19.7m in funding, and reaching $6.7m in sales. All this was accomplished through 175 technical assistance meetings, 45 mentoring sessions, and support for seven SBIR applications[29].

3.1.5.3. National Network for Manufacturing Innovation[30]

The National Network for Manufacturing Innovation (NNMI), also known as Manufacturing USA, is an interagency effort to create regional consortiums for manufacturing innovation. The programme aims to accelerate the development and adoption of advanced manufacturing technologies and processes. NNMI supports a network of Institutes for Manufacturing Innovation. Each institute functions as a public-private membership organisation with a unique technology focus. Collectively they create a manufacturing research infrastructure where manufacturers, university engineering schools, community colleges, Federal agencies, non-profit organisations, entrepreneurs, and regional and state organisations can collaborate on industrially relevant manufacturing technologies. Institute activities include applied research and demonstration projects that reduce the cost and risk of commercializing new technologies or that solve generic industrial problems, education and training, and development of innovative methodologies and practices for supply-chain integration[31].

The NIST hosted interagency Advanced Manufacturing National Program Office (AMNPO) administers NNMI. AMNPO staff includes representatives from NASA, NSF, DoC, DoD, DoE and the Department of Education, as well as fellows from manufacturing companies and universities. The joint federal effort plans to create a network of 15 regional manufacturing institutes funded by a one-time investment of $1 billion over the course of 10 years. Currently there are nine Institutes for Manufacturing Innovation that have attracted over 300 member companies and universities. Six additional institutes are planned for 2017. Over the next five to seven years the US government plans to invest $70-120 million per institute[32]. Each institute will also receive matching private-sector funds. As of 2015, the institutes had received $481 million in private sector funding[33]. The creation of new institutes is managed through an open, competitive selection process.

3.1.6. Small Business Administration

With at least one office in every US State, SBA provides support to entrepreneurs and small businesses through loans, loan guarantees, contracts, counselling sessions and other forms of assistance to small businesses. SBA aims to maintain and strengthen the US economy by enabling the establishment and viability of small businesses. The agency also assists in the economic recovery of communities after disasters. SBA loans are made through banks, credit unions, and other lenders who partner with the SBA. The

[29] https://www.eda.gov/oie/ris/i6/
[30] https://www.manufacturing.gov/funding/
[31] National Network for Manufacturing Innovation. (n.d.). Retrieved October 6, 2016, from http://energy.gov/eere/amo/national-network-manufacturing-innovation
[32] United States of America, Department of Commerce, National Institute of Standards and Technology. (n.d.). NNMI AND NIST. Retrieved December 7, 2016, from https://www.nist.gov/sites/default/files/documents/public_affairs/releases/NNMI_budgetsheet.pdf
[33] ibid.

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agency provides up to a 90 percent government-backed guarantee on part of the loan in order to strengthen access to capital for small businesses. SBA leads government efforts to deliver 23 percent of prime federal contracts to small businesses. The agency also provides grants to support counselling partners. These counselling services provide services to over 1 million entrepreneurs and small business owners annually.

3.1.6.1. Small Business Technology Transfer programme[34]

The interagency Small Business Technology Transfer (STTR) programme forms part of one of the largest Federal programmes supporting public-private partnerships. Created in 1992, the STTR programme distributes competitive innovation awards that expand joint venture opportunities for small businesses and non-profit research institutions by bridging the gap between basic research and the commercialisation of resulting innovations.

The STTR programme aims to stimulate partnerships of ideas and technologies between innovative small businesses and research institutions through federally funded research and development. The STTR programme requires small business applicants to collaborate formally with a non-profit research institution. Under this grant programme, the small business is required to perform at least 40 percent of the work and the research institution must perform at least 30 percent. The remaining 30 percent of the work may be completed by the small business, the research institution, or another third party. The programme follows a three-phase structure. During Phase I, grantees are expected to establish the technical merit, feasibility, and commercial potential of the proposed RDI effort. This phase also allows the government to determine the quality of performance of the small businesses prior to providing additional Federal support in Phase II. Phase I awards provide up to $150,000 in funding for one year. During Phase II, grantees are expected to continue the RDI efforts initiated in Phase I. Funding is based on the results of the Phase I grant and the scientific and technical merit and commercial potential of the proposed Phase II project. Only Phase I awardees are eligible for a Phase II award. Phase II awards provide up to $1 million total funding for 2 years. During Phase III the small businesses are expected to pursue commercialisation of technologies resulting from the Phase I and II RDI activities, where appropriate. The STTR programme does not provide any additional funding for Phase III. In some agencies, Phase III may involve follow-on non-STTR funded RDI or production contracts for products, processes, or services intended for use by the US Government.

Currently, five agencies participate in the STTR programme: DoD, NIH, NASA, DoE, and NSF. Each agency administers its own individual programme in line with its unique mission needs and within the programme guidelines established by Congress. These agencies designate their programme's RDI topics, accept proposals from small businesses, and make awards on a competitive basis. Every agency, including individual divisions within DoD and NIH, manages and operates the STTR programme differently. SBA serves as the coordinating agency for the STTR programme. It directs the agencies' implementation of STTR, reviews their progress, and reports annually to Congress on its operation. SBA is also maintaining an informational website for the STTR programme. Total funding for the STTR programme across all agencies was $263 million in Fiscal Year 2015.

3.2. US Academia-Industry Collaboration Support Schemes at the State Level

3.2.1. Overview

As noted, state and regional support schemes primarily focus on the state or region's priorities and economic needs. These schemes

[34] https://www.sbir.gov/about/about-sttr

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sometimes supplement funding provided at the Federal level, but in other cases they are independent of Federal programmes and designed to address specific regional clusters or business stakeholders. A key feature of the US system is the way in which state universities receive Federal funding which may have broad purposes attached to them, and align their research output with the needs of local industrial and commercial partners.

3.2.2. State and Regional Programme Examples

3.2.2.1. North Carolina Biotechnology Center[35]

The North Carolina Biotechnology Center (NCBiotech), based in Research Triangle Park (RTP) with offices in five other North Carolina cities, is a private, non-profit organisation that aims to generate long-term economic and societal benefits for North Carolina through support of biotechnology research, business, education, and strategic policy[36]. Founded in 1983 by the North Carolina General Assembly, NCBiotech was the first state-sponsored initiative focused on a single sector in the US. Merging the interests of the academic, private, and public sectors, NCBiotech's mission is to secure North Carolina's position as a global leader in the life sciences. The Centre works to strengthen North Carolina's academic and industrial biotechnology research capabilities; foster North Carolina's biotechnology industrial development; work with business, government and academia to move biotechnology from research to commercialisation in North Carolina; inform state residents about the science, applications, benefits and issues of biotechnology; enhance the teaching and workforce-training capabilities of North Carolina's educational institutions; and establish North Carolina as a preeminent international location for the biotechnology industry.

NCBiotech provides grants and loans for research support. The Biotechnology Innovation Grant provides $500k to universities who can secure a dollar-for-dollar match from a corporate partner. The Technology Enhancement Grant helps move technologies to the next level or to leverage university technology. NCBiotech normally receives approximately 20 applications for the three to four grant announcements they put out every year. The Centre's loans are designed to leverage additional investments and to bridge funding gaps in a small company's development. NCBiotech's portfolio is divided evenly between grants and loans.

The Business and Technology Development programme works to attract new companies to the state by introducing them to the researchers and universities that could meet their research and development needs. The programme draws on its 120,000 contacts to identify those researchers that companies can actually form collaborations with. The Centre will work for years to bring a company to the state that it believes it can match with local assets, including research institutions. Currently, NCBiotech primarily works with small and medium sized enterprises, but the centre is actively trying to engage larger companies as well as focus on start-ups. Among other projects, NCBiotech has worked with companies to develop training programmes that prepare the workforce for specific pharmaceutical manufacturing jobs. International partners tend to be less familiar with biotechnology activities in North Carolina than they are with those in Boston and California. The centre works to communicate the value of North Carolina's advanced labour pool, world-class institutions, and relatively low operating costs to international partners. To encourage international partnerships, NCBiotech has extensions in Asia and Europe.

[35] http://www.ncbiotech.org/funding
[36] Biotech Center FAQs. (n.d.). Retrieved December 9, 2016, from http://www.ncbiotech.org/about-us/press-room/biotech-center-faqs#xxx1

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NCBiotech measures the effectiveness of its programmes using several metrics, including how much money the programme brings into the state and how much follow-on funding companies it supports receive. Since 1984, NCBiotech has distributed more than $16 million in state monies to about 90 companies, which has led to more than $1 billion in follow-on funding for those companies[37]. Companies supported by NCBiotech programmes produce $1.7 billion a year in taxes, employ 163,000 people, and support 120,000 indirect jobs. The distribution of funds from NCBiotech has been uneven between urban and rural areas. Although RTP has been the epicentre of biotechnology activity in North Carolina, the Centre is pushing for life sciences activities across the state.

3.2.2.2. Maryland Industrial Partnerships Program[38]

The Maryland Industrial Partnerships (MIPS) Program accelerates corporate technology development and commercialisation through industry-academia research partnerships. Specifically, MIPS helps Maryland companies identify and leverage the research infrastructure and subject matter expertise of Maryland public universities to solve pressing technical challenges and develop new products and processes. Established in 1987, MIPS is a state-funded programme administered by the Maryland Technology Enterprise Institute (Mtech) at the University of Maryland, College Park. MIPS helps businesses throughout Maryland partner with faculty across the fourteen public universities in Maryland. To do this, MIPS personnel assist companies in identifying faculty researchers with the right expertise for the companies' projects. MIPs occasionally refers multiple faculty members to interested companies, who then choose the most appropriate university partner.

To incentivize industry-university collaboration, MIPS grants matching funds to selected industry-sponsored, Maryland public university-based, one- or two-year research projects. MIPS does not fund companies directly. Maryland companies and researchers from any of the state's public universities develop proposals jointly, and MIPS funds are awarded on a competitive basis. Applicants to the MIPS programme must provide a technical proposal describing the scope of the research project and the anticipated results, as well as a business proposal with a plan for commercialisation of the research results.

Proposals are assessed on their technical and economic merits by small expert review teams. Technical reviewers, typically active researchers at Federal laboratories and universities, evaluate the technical feasibility of the project. Economic reviewers with experience in early-stage technology commercialisation evaluate the business, financial, and economic development components of the project. A separate MIPS Evaluation Board composed of representatives from state economic development organisations and university technology transfer offices makes final funding recommendations based on the ratings and comments of the technical and economic reviewers. The primary considerations of the MIPS programme in funding commercialisation research projects are their likelihood of success from a technical perspective, and their potential to make a positive impact on Maryland's state economy[39].

The maximum MIPS contribution to any single project is $100,000 per year. Two-year projects receive funding for the first year if selected, and second-year funding is awarded on a renewal basis, contingent upon satisfactory progress of the project in its first year. The required portion of industry funding of projects is on a sliding scale, and increases with company size. Companies are also required to make an in-kind contribution of work on the project in the form of salaries of corporate researchers, materials and equipment, travel or other related expenses. MIPS awards two rounds of grants per year, with each round typically awarding a total

[37] ibid.
[38] http://www.mips.umd.edu/applying.html
[39] Selection Process & Criteria. (n.d.). Retrieved December 8, 2016, from http://www.mips.umd.edu/applying.html#selection_process_criteria

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of $3 million to $5 million (combined MIPS and industry contributions) in funding across 15-20 projects. The second round of 2015 MIPS grants supported 16 technology development projects, with projects ranging in size from $135,000 to $426,952 for a total value of $3 million[40].

3.2.3. University Coordination Examples

The two cases outlined below highlight the independent, strategic and complex strategies pursued by major STI universities in the US. It is at the level of individual institutions where the key initiatives in academia-industry collaboration are developed and executed. While barriers continue to exist (especially in regards to IP), the leading STI institutions in the US seek out, engage, and collaborate with businesses largely through their own initiatives. Likewise, businesses search for, and negotiate with on a one-on-one basis, those institutions with the mix of technology and talent that best meet their needs. Large multi-national businesses are well represented in university partnerships. Their experience with the legal and administrative challenges of working across borders makes industry-academia collaboration relatively easy. Foreign firms with little experience of this kind, however, face a steep learning curve when seeking collaboration with US institutions. They are often unfamiliar with the Bayh-Dole Act and standard university IP processes. US and EU universities, however, have some similarities in their corporate partnership processes, making it easier for EU companies to establish relationships with American universities. While the cases below represent excellent practice, it is fair to say that institutions across the US pursue similar activities and similar goals. The practices detailed in the examples below are common at other US universities that are open to European collaboration (e.g., Rutgers, The State University of New Jersey and the University of Pennsylvania have similar programmes).

3.2.3.1. Georgia Institute of Technology Office of Industry Collaboration[41]

The Georgia Institute of Technology (Georgia Tech) Office of Industry Collaboration (OIC) provides personalized service to companies seeking to establish strategic relationships with the university. One of the office's main responsibilities is to adapt Georgia Tech's services to the needs and expectations of its corporate partners. OIC crafts, nurtures, and expands these relationships by helping research units across the university tailor their relationships with corporate partners. OIC also assesses market opportunities, develops corporate access strategies, and supports public-private funding opportunities.

Georgia Tech's relationships with corporate partners fall into six broad categories: engagement and recruitment of students, including sponsored research, internships, educational support, and co-ops; access to university-conducted RDI capabilities; connection to start-ups; on campus innovation centres that give corporations a vehicle for facilitating partnerships and collaboration, building and staffing technology labs, and supporting recruitment activities; technology licensing; and workforce development with tailored training programmes. A full relationship between Georgia Tech and a corporate partner could include all the above in addition to co-direction of doctoral students, vendor relationships, and visiting scholar opportunities.

To tailor its relationships, Georgia Tech first ensures that it knows what type of interaction a corporation is looking for and the company's expectations for such interactions. The university listens to the company to gain a clear understanding of its short- and long-term goals. Companies establish relationships with Georgia Tech for many reasons, including capitalizing on specific expertise

[40] Maryland Technology Enterprise Institute, Maryland Industrial Partnerships Program. (2015, September 9). *Maryland technology companies, university faculty team to develop 16 new products through UMD program* [Press release]. *Maryland Technology Enterprise Institute*. Retrieved December 8, 2016, from http://www.mtech.umd.edu/media/release.php?id=392

[41] http://www.research.gatech.edu/faculty-and-staff-resources/funding

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or special facilities; keeping abreast of emerging technologies; and recruiting students they are otherwise having difficulty recruiting. OIC makes sure the university understands these reasons at the beginning of an engagement. OIC also considers a company's previous relationships with universities when evaluating a potential corporate relationship. When establishing innovation centres, OIC strives to make sure corporations have a clear purpose for doing so. OIC considers a mutual understanding of what constitutes value creation for both the company and the university fundamental to all partnerships. To expand interactions with its current partners, Georgia Tech establishes innovation councils, during which the university can discuss the next horizons for the relationship, introduce companies to faculty they haven't worked with before, and introduce companies to start-ups from Georgia Tech's incubator.

Georgia Tech evaluates the effectiveness of its university-industry partnerships relative to a series of value propositions. These propositions include the value of sponsored research, both in dollar amount and strategic positioning; client activity, including volume of interactions, impact, and types of engagement; start-up activity, especially whether money is flowing from corporate partners to Georgia Tech start-ups; and patent velocity, or the time from when Georgia Tech receives a patent and when that patent is used in commercial activity. Georgia Tech currently has $765 million in funding for research. Of this funding, $100 million comes from its 450 corporate partners.

3.2.3.2. Carnegie Mellon University Office of Corporate and Institutional Partnerships[42]

The Carnegie Mellon University (CMU) Office of Corporate and Institutional Partnerships is responsible for philanthropic partnerships and serves as a university concierge for the private sector. As such, the Office ensures companies have a clear point of contact within the university that is able to review all inbound inquiries regarding strategic partnerships. The office works to optimize business interests in recruiting graduates and working with professors, and assists companies in building strategic partnerships with the university in areas such as sponsored research, recruitment, technology transfer, continuing education, and philanthropy. Strategic partnerships at CMU provide companies with access to cutting-edge research, and provide students with invaluable real-world experience. It also offers CMU the opportunity to promote its intellectual property and expose its corporate partners to start-ups created by the university.

CMU engages with industry from ideation to tech transfer and start-up. The Office of Corporate and Institutional Partnerships helps companies endow distinguished professorships or chairs; arrange fellowships, scholarships, and paid internship opportunities for students; fund student organisations; fund existing and new facilities; provide funding and equipment for research; and encourage employee philanthropy through matching employee contributions. The Office facilitates campus visits from companies interested in recruiting on campus and directs companies to the appropriate contacts for technology transfer. The Office also helps arrange CMU-based opportunities for professional and executive education, including graduate degrees, executive education programmes, distance learning, expert speakers, seminars, conferences, specialized courses, and workshops. Companies also can establish industry affiliate programmes in which they pay a flat fee on an annual basis for the university to prepare work for them.

The Office of Corporate and Institutional Partnerships works closely with the provost for research and with faculty and researchers to keep abreast of the latest developments emerging from CMU's labs and centres. Each research department has staff with experience in negotiating with industry. The Office maintains relationships with all of these staff members, acting as a resource for the research departments as they establish research agreements. Through these relationships, the Office ensures that it has a full

[42] http://www.cmu.edu/corporate/partnerships/

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view of the university and its corporate relationships and thus can maximize partnership opportunities. The Office remains involved across the lifetime of collaborations, not just through the negotiation phase. Sponsored research agreements at CMU must have a budget of at least a half million dollars.

Companies that have a particular interest in work with CMU faculty often open an office in Pittsburgh to facilitate collaboration. CMU does not have a dedicated business park and instead works with the city and county to find space for its corporate partners. As a result, Pittsburgh has created an ecosystem conducive to university-industry interactions. The Office of Corporate and Institutional Partnerships operates with a small staff. However, to facilitate corporate partnerships, the Office regularly holds an all staff meeting in which everyone in the university who is responsible for industry relations attends, including those responsible for tech transfer, gift funding, research funding, and career services. The Office assesses its effectiveness based on the amount of gift funding and sponsored research it brings in. In the future, it might also assess CMU’s ability to convert relationships with companies into corporate collocations in Pittsburgh.

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4. EU ACADEMIA-INDUSTRY COLLABORATION SUPPORT SCHEMES

The European Commission (EC) represents the interests of the EU as a whole. The EC proposes new legislation to the European Parliament and the Council of the EU, and it ensures EU law is correctly applied by MS. The EC is composed of several Directorate-Generals (DGs). This section aims at describing the main EU academia-industry collaboration support schemes taking into consideration the selection criteria and structure defined in Section 2. As previously mentioned, programmes should be considered at both the EC and MS levels, focusing on the most relevant initiatives that are currently open for application. In this sense, the following programmes were selected and positioned according to the following structure:

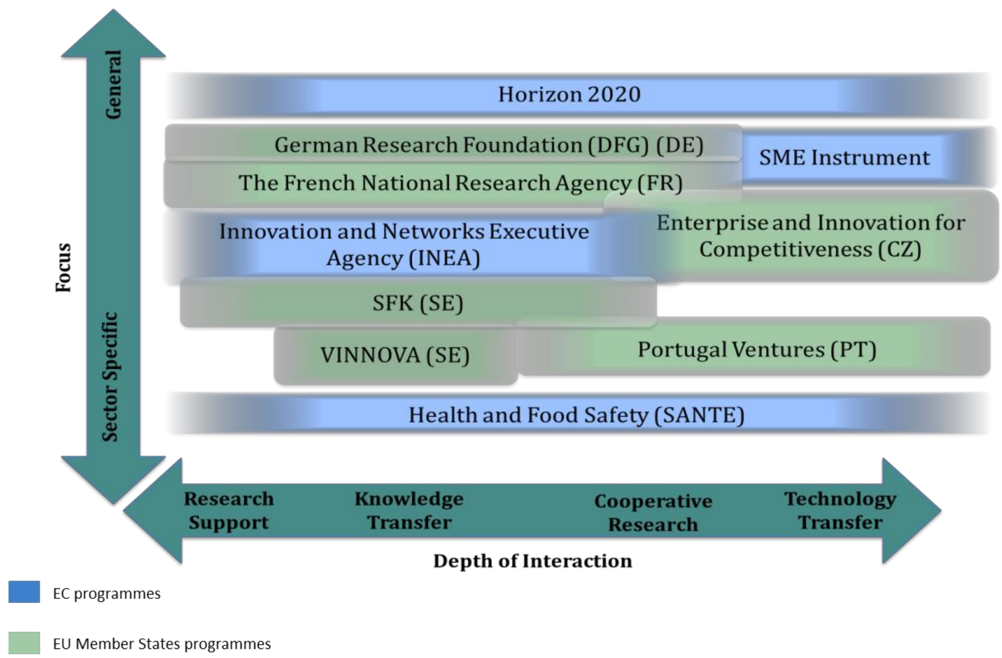

Figure 2 – EU programmes selected for the analysis

In total, four programmes at the EC level (sub-section 4.1) and six programmes from five different relevant MS countries at the EU level (sub-section 4.2) were selected according to the specific selection criteria.

4.1. EU Academia-Industry Collaboration Support Schemes at the EC Level

4.1.1. Overview

The EC identified the importance of improving knowledge transfer between public research institutions and third parties as one of its main areas of action. When comparing with North America, the average university in Europe generates far fewer patents, which represents a relevant indicator for improvement. However, interactions between public research institutions and industry players have been increasing over time, involving knowledge transfer between stakeholders, generating in new products, organisations

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and jobs[43].

In Europe, several Directorate-Generals (DGs) under the EC play active roles with regard to STI, among which the more notable are the DG for Research and Innovation (DG RTD) and the DG for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) DG RTD defines and implements European research and innovation policies with a view to achieving the goals of the Europe 2020 strategy and its key flagship initiative, the Innovation Union. DG GROW aims to facilitate the process of turning the EU into a smart, sustainable and inclusive economy. In addition, there is the DG for Regional Policy (DG REGIO), that aims to enhance economic, social and territorial cohesion, reducing disparities between regional and national levels of development, the DG for Energy (DG ENER) that develops and implements the EU's energy policy and the DG for Health and Food Safety (DG SANTE), which is also subject to this deliverable.

Moreover, there are a number of distinct EU agencies that offer information or advice to the EU institutions. The MS and EU citizens also contribute extensively to the shaping and development of the European STI landscape by executing specific EU programmes under a target area (e.g. Innovation and Networks Executive Agency (INEA) or the Executive Agency for Small and Medium-sized Enterprises (EASME)). In this sense, several programmes are assessed in this section taking into consideration the different DGs and Executive Agencies at the EU level:

- DG for Research and Innovation (DG RTD)
- Executive Agency for Small and Medium-sized Enterprises (EASME)
- Innovation and Networks Executive Agency (INEA)
- DG for Health and Food Safety (DG SANTE)
- Other relevant entities and programmes that support academia-industry collaboration

4.1.2. Directorate-General for Research and Innovation (DG RTD)

The DG RTD is responsible for defining and implementing the European Research and Innovation policy aiming to achieve the goals of the Europe 2020 strategy the DG RTD monitors and contributes to the development of the Innovation Union flagship initiative and the completion of the European Research Area (ERA), which includes funding research and innovation through framework programmes, such as the Horizon 2020 (H2020)[44]. The DG also supervises organisations such as the European Research Council (ERC), and promotes initiatives among EU MS, such as the Joint Programming Initiatives (JPIs). In the present section, the Deliverable focuses on the H2020 programme, considered to be the most relevant action under the DG RTD.

4.1.2.1. Horizon 2020 Programme[45]

The H2020[46] is the EU's framework programme for Research and Innovation for the period of 2014-2020. It will run from 2014 to 2020 and aims to lead to more breakthroughs, discoveries and world-firsts by taking ideas from the lab to the market. H2020 is the largest EU research and innovation funding programme ever, with nearly €80 billion (approximately $89.22 billion) of funding available over seven years. It replaces the Seventh Framework Programme (FP7), which ran from 2007 to 2013 with a budget of

[43] Improving knowledge transfer between research institutions and industry across Europe: embracing open innovation, European Commission (2007)
[44] http://ec.europa.eu/research/index.cfm?pg=dg
[45] http://ec.europa.eu/research/participants/portal/desktop/en/funding/index.html
[46] http://ec.europa.eu/programmes/horizon2020/

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around €55 billion (approximately $61 billion). By coupling research and innovation, H2020 brings together the existing EU research and innovation funding, focusing on smart investment and enabling ideas to reach the market faster.

Under the H2020 Programme, there are several initiatives that promote cooperation between academia and industry. A good example is the H2020 SME Innovation Associate, a programme that supports 90 SMEs to hire a researcher to bring their ideas to market[47]. This action aims at overcoming barriers for EU SMEs and start-ups to the recruitment of highly qualified specialists (PhD or equivalent) that do not have a job in their national market, but whose knowledge would be crucial to open new opportunities for innovation and significant growth for the company. SMEs and PhDs outside the EU can participate in the H2020 Programme in cases when they are from countries associated to H2020.

According to the EC, a beneficiary in H2020 is "the legal person, other than the European Commission, who is a Party in the Grant Agreement". In this sense, the range of beneficiaries within the H2020 is quite wide, including private companies (including SMEs), universities, research centres, governmental associations, among others.

In terms of the main instruments and processes to support industry-academia collaboration, the programme is divided into three pillars: excellent science, industrial leadership and societal challenges. In each pillar, the programmes promote the development of consortia of partners from different countries, as well as from the industry and academia sides, enhancing joint cooperation actions. Regarding the selection process, this is developed through a competitive bid and evaluated by experts in the specific field of the proposal submitted. Regarding the evaluation process for full proposals, each criterion (Excellence, Impact and Quality and efficiency of the implementation) are scored out of 5. The threshold for individual criteria is 3. For the evaluation of first-stage proposals under a two-stage submission procedure, only the criteria "excellence" and "impact" are evaluated. The threshold for both individual criteria is 4. Prioritisation is given when needed according to the size of budget allocated to SMEs and gender balance among the (primary) personnel in the proposal.

Concerning its international dimension, H2020 is fully open to international participation in all fields and areas. Specific targeted international cooperation activities are included in all sections of H2020 such as "Societal Challenges", "Enabling and Industrial Technologies" and others. Applicants from non-EU countries (or "third countries") are always free to take part in H2020 programmes even if the call for proposals or topic text do not state this explicitly, although in a high number of cases, partners do not receive direct funding from the EC. In terms of opportunities that perceive the specific cooperation with the US, some are open for participation at the time of this Deliverable, namely: ICT-31-2017, SwafS-14-2017 and INNOSUP-08-2017.

4.1.3. Executive Agency for Small and Medium-sized Enterprises (EASME)

The Executive Agency for Small and Medium-sized Enterprises (EASME) is an agency set-up by the EC that aims to manage on its behalf several EU programmes. More specifically, the executive agency manages: most of the Competitiveness of Enterprises and Small and Medium-sized Enterprises (COSME); part of H2020, the EU's Framework Programme for Research and Innovation, in particular: the SME instrument, the SME Innovation Associate and the Fast Track to Innovation (FTI) Pilot, part of "Pillar II – Industrial leadership", including Innovation in SMEs, the Sustainable Industry Low Carbon Scheme (SILC II) and part of the Leadership in Enabling and Industrial Technologies; and part of "Pillar III – Societal challenges", namely a part of challenge three – "Secure, Clean and Efficient Energy", and challenge five – "Climate action, Environment, Resource Efficiency and Raw Materials"; part of the LIFE

[47] https://ec.europa.eu/easme/en/h2020-sme-innovation-associate

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programme concerning the EU environment and climate policy; part of the European Maritime and Fisheries Fund (EMFF); and the legacy of the Intelligent Energy – Europe programme and the Eco-innovation initiative.

Furthermore, EASME focuses on four thematic areas of action: SME support, Energy, Environment and Maritime. Within the H2020 part that is managed by EASME, it is relevant to highlight the SME Instrument programme, which aims to support highly innovative SMEs.

4.1.3.1. The SME Instrument[48]

As previously mentioned, the SME Instrument supports high-potential SMEs to develop ground-breaking innovative ideas for products, services or processes that are ready to face global market competition. During the first two years of implementation (2014-2015), more than 1,200 SMEs were selected to receive funding under the programme. The programme provides around €3 billion in funding over the period of 2014-2020. In total, €513 million were invested in the success of innovative SMEs. It is expected that by the end of the H2020, the SME instrument has supported around 7,500 SMEs to get their innovations applied into the market.

In terms of types of collaboration supported, the innovation projects supported under the programme are sustained by a strategic business plan that is potentially elaborated and partially funded through Phase 1 of the SME Instrument. The outcomes of the projects include: a new product, process or service that is market-ready; a business innovation plan including a detailed commercialisation strategy; and a financing plan for a market launch.

Regarding the main beneficiaries, under the SME Instrument, only SMEs are eligible to apply to funding, as the main objective is to strengthen the competitiveness of the EU industry by promoting the growth of SMEs through innovation. SMEs must submit a business plan indicating the details of the business strategy of the project.

The innovation projects (indicated above) of typically 1-2 years range from €500,000 to €2.5 million. These projects promote the cooperation between academia and industry, since the activities funded under these projects include: prototyping, miniaturisation, scaling-up, design, performance verification, testing, demonstration, development of pilot lines and validation for market replication. Although 70% of the eligible costs are covered by the SME Instrument, the rest (30%) needs to be funded by the SMEs[49].

Concerning its international dimension, the SME instruments fund missions for SMEs from the EU (typically 10 SMEs) to travel and meet companies outside the EU. These are Business to Business (B2B) missions so the main objective is to promote the internationalisation of SMEs. Although the travel costs need to be covered by the SMEs, all the costs related to the planning and conduction of these B2B missions are directly funded by the SME Instruments (often through sub-contractors).

4.1.4. Innovation and Networks Executive Agency (INEA)

INEA manages infrastructure and research projects in the fields of transport, energy and telecommunications. More specifically, the programme "Connecting Europe Facility", focuses on transport, energy and digital telecommunications. In addition, the Agency supports two initiatives of H2020: a) Smart green and integrated transport; and b) Secure, clean and efficient energy. INEA is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA), which was created by the European Commission

[48] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/sme-instrument
[49] https://ec.europa.eu/programmes/horizon2020/en/h2020-section/sme-instrument

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in 2006 to manage the technical and financial implementation of its TEN-T programme. INEA officially started its activities in 2014 aiming to implement the following EU programmes: Connecting Europe Facility (CEF); Parts of H2020 – Smart, green and integrated transport and the Secure, clean and efficient energy; Legacy programmes TEN-T and Marco Polo 2007-2013. INEA's main objective is to increase the efficiency of the technical and financial capabilities of the programmes it manages. This report will focus on the implementation of the H2020 by INEA, focusing on the academia-industry collaboration opportunities.

4.1.4.1. INEA academia-industry programmes[50]

INEA[51] is the successor of the Trans-European Transport Network Executive Agency (TEN-T EA), which was created by the European Commission in 2006 to manage the technical and financial implementation of its TEN-T programme. INEA officially started its activities in 2014 aiming to implement the following EU programmes: Connecting Europe Facility (CEF); Parts of H2020 – Smart, green and integrated transport and the Secure, clean and efficient energy; Legacy programmes TEN-T and Marco Polo 2007-2013.

According to the interviewee, in terms of the Smart, green and integrated transport and the Secure, clean and efficient energy societal challenges, the programme has a total of close to €6.9 billion for a period of around five years. In terms of average funding and according to the interviewee, this can be diverse ranging from €2 million to €25 million per project. INEA tries to promote that these consortiums consist of a mixture between academia and industry, including partners from each side, namely in the Innovation Actions (IA) and in the Research and Innovation Actions (RIA) of the H2020.

As previously described, the financed projects range in terms of funding and consortium size. Concerning the type of collaboration support, it is relevant to highlight the different levels of Technology Readiness Level (TRL). The projects that are closer to the market have a higher TRL. According to the interview results, there is a higher need for bigger projects with high TRL that are disruptive. In addition, it is also relevant to have projects with lower levels of TRL, so there can be a mixture of projects that are closer to the market and the academia. Regarding the main beneficiaries, these range from different types of institutions such as private companies, universities, research centres, governmental organisations, among others. The consortia that present proposals can vary from 5 to 20-30 members each.

In terms of the main instruments, it is relevant to highlight the main action taken in terms of selection and monitoring and evaluation actions. In terms of the selection process, this is always developed through a competitive bid and evaluated by experts in the specific field. The selection of experts that evaluate each proposal fits with a profile that can provide the perspective from the industry and the academic fields.

Regarding the monitoring process, this is done by mainly two elements: publication and peer review in journals for research; and patents and applications for patents. In this sense, joint publications between public and private entities are an example of monitoring actions that are deployed by INEA. However, the higher involvement of the industry makes it more difficult to assess the impact of a particular project.

Regarding the international dimension, there is not a specific drive for geographical focus – the opportunities are launched at the EU-level and sometimes perceives the inclusion of other countries such as the US, Brazil and China. In regard to the US, the programme is particularly important due to the nature of the subject (transportation, security, energy, etc.) that concerns both the

[50] https://ec.europa.eu/inea/en/ten-t
[51] http://ec.europa.eu/inea/en

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EU and the US.

4.1.5. Directorate-General Health and Food Safety (DG SANTE)

The Directorate-General Health and Food Safety (DG SANTE) aims at making Europe a healthier, safer place, where citizens can be confident that their interests are protected. Its specific objectives are: to protect and improve public health; to ensure Europe's food is safe and wholesome; to protect the health and welfare of farm animals; and to protect the health of crops and forests. These objectives are achieved by: monitoring traders, manufacturers and food producers to ensure that they stick to EU laws on food and product safety, consumer rights or public health; ensuring that all concerns on trade, competitiveness and the environment of stakeholders are being listened and taken in account when developing related EU policies; and supporting national or regional authorities to propose a mixture of laws, projects and other measures on health and food safety.

In 2006, DG SANTE launched the public Health-EU portal[52] to provide European citizens with easy access to comprehensive information on Public Health initiatives and programmes at EU level. The portal is intended to help meet EU objectives in the Public Health field, as it is an important instrument to positively influence behaviour and promote the steady improvement of public health in the EU MS. The Portal is an initiative of the Community Public Health Programme 2003-2008 intended to permit greater involvement of individuals, institutions, associations, organisations and bodies in the health sector by facilitating consultation and participation. Since 2014, the Call for Proposals under the Third Health Programme[53] are being published in parallel at the webpages of The Consumers, Health, Agriculture and Food Executive Agency (Chafea) as well as in the EU Research & Innovation Participant Portal.

In addition, DG SANTE is developing a programme that proposes cooperation among healthcare systems in order to jointly overcome barriers that require highly specialized healthcare knowledge and resources. In this sense, the European Reference Networks (ERN) aims to tackle those barriers and improve the quality and cost-effectiveness of healthcare in the EU.

4.1.5.1. European Reference Networks (ERN)[54]

The main goal of ERN is not to create new healthcare centres but rather link existing ones and recognize existing networks that will work as permanent platforms at the EU level[55]. The projects on ERN are financed by CHAFEA, which manages the calls for proposals and organises the funding programme. The main benefits that come from ERN are related with the higher-quality specialized care, improved European cooperation, enhanced provision of highly specialized care, among others. In terms of quantitative overview, the grants provided under the Health Programme allocates budget for research support actions that are connected with industry cooperation.

Regarding the types of supported academia-industry collaboration, the projects funded through the ERN focus on the provision of highly specialised care as well as to support knowledge transfer.

The main end-beneficiaries of the programme are the patients themselves, but the directive applies to healthcare providers interested in forming an ERN. A minimum of 10 Member Applicants from at least eight MS are needed.

[52] http://www.openclinical.org/publicApp_Health-EU.html
[53] http://ec.europa.eu/chafea/health/index.html
[54] http://ec.europa.eu/health/ern/board_member_states_en
[55] http://ec.europa.eu/health/ern/policy_en

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In terms of the main instruments and processes used for collaboration, DG SANTE launched a public call for applications in 2016. In total, 24 applications received 370 hospitals and almost 1,000 highly specialised units were involved in the process. Regarding ERN's international dimension, cooperation is perceived at the EU-level according to the different members of the ERN.

4.1.6. Other relevant entities and programmes that support academia-industry collaboration

4.1.6.1. Directorate-General for Energy (DG ENER)[56]

The Directorate-General for Energy (DG ENER) develops and implements the EU's energy policy – secure, sustainable, and competitive energy for Europe, thus supporting the Europe 2020 economic strategy which, for energy, is captured in the Energy 2020 strategy. To do so, DG ENER promotes the completion of the internal energy market and monitors its evolution, supports the reinforcement of energy infrastructure, ensures safe and competitive conditions for energy sources exploitation, and develops the nuclear energy framework and facilitates energy technology innovation, among others tasks.

To facilitate energy technology innovation, DG ENER supports several funding programmes, such as the European Energy Programme for Recovery (EEPR), which finances key energy projects; the Connecting Europe Facility (CEF) Programme, which funds trans-European energy infrastructure projects; and the energy projects of H2020.

As explained in section 4.1.2, H2020 is the EU's Framework Programme for Research and Innovation for the period 2014 – 2020. Although DG RTD is the main coordinator of the Programme, DG ENER supports the implementation of energy projects with the collaboration of the Innovation and Networks Executive Agency (INEA) and the Executive Agency for Small and Medium-sized Enterprises (EASME). In this regard, H2020 provides €5.9 billion (approximately $6.6 billion) to fund energy projects that aid in the creation and improvement of clean energy technologies such as smart energy networks, tidal power, and energy storage.

4.1.6.2. Directorate-General for Regional Policy (DG REGIO)[57]

The Directorate-General for Regional Policy (DG REGIO) aims to enhance the economic, social and territorial cohesion, reducing disparities between regional and national levels of development. In this sense, DG REGIO supports innovation and R&D actions through the development of relevant partnerships between businesses, research institutions, academic actors and other public bodies. These key players are addressed at the regional level. Investment is made in four areas: R&D and innovation; entrepreneurship; ICT take-up; and human capital development.

Furthermore, the EC encourages MS and regions to optimise coordination actions with the Cohesion Policy investments and EU programmes managed centrally. The support provided at the RDI level is mainly developed through the following funding initiatives:

- European Regional Development Fund (ERDF)
- European Social Fund (ESF)
- Cohesion Fund (CF)
- European Agricultural Fund for Rural Development (EAFRD)

[56] https://ec.europa.eu/energy/en/funding-and-contracts
[57] http://ec.europa.eu/regional_policy/en/

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- European Maritime and Fisheries Fund (EMFF)

Regarding the application process for funding opportunities, the applicants should provide proposals to the authority managing the regional programme. The organisations that can benefit from these funds include public bodies, some private sector organisations, academia players, and associations, among others.

4.1.6.3. Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW)[58]

The Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs (DG GROW) aims to promote growth in Europe. DG GROW works to ensure an open internal market for goods and services, free movement of professionals in EU, and better access to public contracts. It implements industrial and sectorial policies of the Europe 2020 strategy; fosters entrepreneurship and business growth, including facilitating the access to funding and global markets, especially concerning SMEs; and delivers the EU's space policy via the Copernicus[59] and Galileo[60] programmes; as well as research actions to spur technological innovation and economic growth, supporting funding programmes such as COSME and H2020. In regard to H2020, DG GROW supports the areas of space, raw materials and SME's innovation. Furthermore, DG GROW supports high-level political and business meetings, such as the Missions for Growth initiative, and IPR policies, e.g. through the support of the IPR SME Helpdesks. The Mission for Growth[61] initiative is a series of global business diplomacy missions that combine business and political interests in areas related to DG GROW's policy. They allow for high-level contacts between the Commissioner of this DG, entrepreneurs and political authorities, and offer a unique opportunity to discuss mutually-beneficial policy and make links with businesses in the countries involved. Furthermore, missions targeting industrial sectors or specific areas allow participants to explore prospects for potential investment or industrial cooperation between companies. They offer the opportunity to explain and provide information on key European programmes (e.g. H2020) and help SMEs to find new partners abroad; thus, facilitating the development of international cooperative projects.

4.1.6.4. EU programme for the competitiveness of enterprises and SMEs (COSME)[62]

COSME[63] is the EU programme for the competitiveness of enterprises and SMEs. The programme was implemented under the Small Business Act (SBA)[64]. It supports SMEs in the following areas: facilitating access to finance, internationalisation and access to markets, creating an environment favourable to competitiveness and encouraging an entrepreneurial culture. COSME is running from 2014 to 2020, with a budget of €2.3 billion.

In terms of facilitating access to finance, the programme supports SMEs in all stages – creation expansion or business transfer. The businesses can obtain easier access to guarantees, loans and equity capital. Regarding the opening to markets, COSME supports the access to new markets through the Enterprise Europe Network (EEN), helping SMEs to find partners and understanding the EU legislation. In addition, the SME Internationalisation Portal supports companies that want to develop activities outside Europe. In terms of support to entrepreneurs, the programme focuses on education, mentoring and guidance actions. Concerning the improvement of business conditions, COSME aims to reduce administrative and regulatory issues for the businesses, supporting

[58] http://ec.europa.eu/growth/index_en
[59] European Earth observation satellite system
[60] European global navigation satellite system
[61] http://ec.europa.eu/growth/industry/international-aspects/missions-for-growth/index_en.htm
[62] https://ec.europa.eu/growth/smes/cosme_pt
[63] http://ec.europa.eu/growth/smes/cosme/index_en.htm
[64] http://ec.europa.eu/growth/smes/business-friendly-environment/small-business-act/index_en.htm

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their competitiveness and encouraging new business practices.

4.2. EU Academia-Industry Collaboration Support Schemes at the Member States Level

4.2.1. Overview

Cooperation between EU MS will continue to be a priority to promote cooperation between academia and industry. Major policy initiatives in this area taken by MS should be reflected in the national reform programmes, and the exchange of good practice will continue to be promoted by the Commission[65].

This section provides both an overview of the MS' approach to academia-industry cooperation and a general analysis of the Structural Funds used by the different MS. The MS have been selected by considering the following criteria:

- Economy size of the MS – two largest EU economies (minus UK) have been selected (Germany and France).
- Geographic dispersion in Europe – in addition to Western Europe (Germany and France), one country from Southern Europe (Portugal), one country from eastern/central Europe (Czech Republic) and one country from northern Europe (Sweden) have been selected.

From the targeted MS, only undergoing national funding programmes publicly available are detailed in this section (from 4.2.2 to 4.2.6). An international component was also considered to be a positive selection criterion, specifically academia-industry programmes which promote international cooperation in particular between the EU and US. In addition, innovation leaders and established programme owners were selected for the analysis. In this sense, the following agencies are analysed for each country: Fraunhofer Institutes and the German Research Foundation (DFG) in Germany; French National Research Agency (ANR) in France; Portugal Ventures in Portugal; Vinnova & Swedish Knowledge Foundation (SKF) in Sweden; and CzechInvest in Czech Republic.

The selection of five MS was conducted taking into consideration the countries' economic size and geographic dispersion, in order to have a representative sample of the European academia-industry ecosystem. There are several innovation agencies throughout Europe that would be potentially relevant to analyse under this study that are not reflected in this report, such as the Austrian Research Promotion Agency (FFG), due to the selection criteria developed for the analysis of different countries (e.g., Austria is not included). However, the FFG is a good practice example of an innovation agency at the EU level that provides funding for academia-industry cooperation. FFG is the national funding agency for industrial research and development in Austria. As a "one-stop shop" offering a diversified and targeted programme portfolio, the FFG gives Austrian businesses and research facilities quick and uncomplicated access to research funding. In 2015, FFG provided a total of 467€ million in funds. FFG programmes that specifically support industry-academia collaboration include: Academia plus Business (AplusB)[66], Competence Centres for Excellent Technologies (COMET)[67], BRIDGE[68], Innovation Voucher[69], and R&D Competences for Industry[70]. The support provided by FFG in terms of programmes to promote academia-industry cooperation is of great importance for the study and serves as a good example

[65] http://ec.europa.eu/invest-in-research/pdf/download_en/knowledge_transfe_07.pdf
[66] www.ffg.at/en/aplusb-academia-plus-business
[67] www.ffg.at/en/comet-competence-centers-excellent-technologies
[68] www.ffg.at/en/bridge
[69] www.ffg.at/en/innovation-voucher
[70] www.ffg.at/en/rd-competences-industry

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within the report objectives.

As previously discussed in Section 4.1.6, there are five EU's Structural and Investment Funds (the ESI Funds). The purpose of these funds is to generate smart, sustainable and inclusive growth in the EU. The outermost regions should benefit from specific measures and from additional funding to offset their structural social and economic situation. The funds provided under the ESI are managed by the different EU countries through partnership agreements. In this sense, each country agrees with the EC the funds that will be used during the period of 2014-2020. In terms of investment areas, the following are perceived:

- Jobs, growth and investment
- Digital single market
- Energy union and climate
- Internal market
- Economic and monetary union
- Justice and fundamental rights
- Migration[71]

The budget allocated to each country depends on the negotiations with the EC and varies accordingly. In terms of the budget allocated per area, the EC has provided a total of more than 65€ billion for the theme of Research & Innovation among the different EU countries[72].

4.2.2. Germany

German companies are among the most innovative in Europe. Industry-based and financed investments account for more than two-thirds of all RDI funding in Germany. Industry and research cooperate in many areas. For example, there are numerous joint programmes and research projects involving companies as well as research and research-funding organisations.

Roughly 31% of internal RDI spending in industry was invested in the automotive sector, approximately 18% in the electrical engineering sector, a good 14% in the chemical and pharmaceutical industries and about 10% in mechanical engineering. Particularly in the field of applied research, companies work with universities and research institutes on joint projects that are co-funded by public institutions. The most RDI employees in German industry, roughly 25%, are employed by the automotive industry; while over 20% work in the electrical engineering sector and approximately 11% in the chemical and pharmaceutical industry. Volkswagen, Daimler and BMW are the top three companies in Europe when it comes to RDI investment. German companies take five out of the six top places and 25 of the top 100 in the European ranking of corporate research spending.

The German Federal government has published its High-Tech Strategy in 2014, which is a strategy aiming at moving Germany forward on its way to becoming a worldwide innovation leader. The goal is for good ideas to be translated quickly into innovative products and services.

The Federal Funding Advisory Service on Research and Innovation is the central point of contact for any questions concerning research and innovation funding. The centre informs potential applicants about the federal research structure, funding

[71] https://ec.europa.eu/info/funding-tenders/european-structural-and-investment-funds_en
[72] https://cohesiondata.ec.europa.eu/

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programmes and the persons to contact, as well as about current funding priorities and initiatives. Here one can find programmes such as "Research in Germany – Land of Ideas", which is financed by the German Federal Ministry for Education and Research (BMBF), and the GTAI – Germany Trade & Invest, which is the economic development agency of the Germany and is financed by the Federal Ministry of Economic Affairs and Energy. The agency has more than 50 offices in Germany and abroad. Its foreign offices support German companies becoming established in the foreign markets and promote Germany as a business location and assists foreign companies setting up in Germany.

The Central Innovation Programme for SMEs (ZIM; Zentrales Innovationsprogramm Mittelstand) is a funding programme for SMEs with business operations in Germany which want to develop new or significantly improve existing products, processes or technical services. Public and private non-profit research and technology organisations (RTO) acting as cooperation partners of SMEs are also eligible for ZIM-funding. Within ZIM, there are different possibilities to cooperate with transnational partners. German companies working with foreign partners in a ZIM project receive a bonus of 10% on top of the regular funding rates, to a maximum of 55%. This programme is financed by the Federal Ministry of Economic Affairs and Energy.

It is also worth mentioning, the German Center for Research Innovation (GCRI) New York, which aims to disseminate German innovations in the US and enable links between German academia-industry and governmental organizations with their counterparts in the US. The GCRI New York facilitates transatlantic collaboration by bringing together leaders in science and technology. The GCRI provides a platform to promote creativity and enhance innovation[73].

For the purpose of the Deliverable and in addition to the above-mentioned programmes, Fraunhofer Institutes and DFG as financial independent institutions are analysed, which is considered to have a significant focus on technology transfer actions between the academia and industry.

4.2.2.1. Fraunhofer Institutes[74]

The Fraunhofer Institutes fund numerous projects where academia and industry from different zones of the globe cooperate with German companies. When there is a knowledge/technology gap in the German Industry, companies tend to contact the head of the Fraunhofer Institutes as they are very close to the solutions (often hold a Professorship at the University). In some cases, the solutions are outside Europe. Therefore, collaborations are established with foreign research institutes. These technology transfer projects are funded by private funds (companies with the technology gap, financing 30% of the projects), besides the public funds from the Fraunhofer Institutes. In particularly with the US, Fraunhofer has a centre located in the country, having a diversity of projects between the EU and US, promoting the participation of EU researchers in Fraunhofer US programmes.

4.2.2.2. German Research Foundation (DFG)[75]

As mentioned, the German Research Foundation (DFG) supports knowledge transfer between research and industry. DFG has a budget of 2.9€ billion (2015): this budget comes from federal (67%) and state funds (33%) and at a smaller basis from foundations and the EU. DFG Funds for technology transfer projects are often in the engineering industrial sectors and range from €100 to €200,000. In those cases, DFG funds only correspond to half of the investment required for the execution of the project which often lasts for 1 or 2 years. The other half of the investment is supported by the industrial partners of the project.

[73] https://www.germaninnovation.org/about-us
[74] https://www.fraunhofer.de/en.html
[75] http://www.dfg.de/en/research_funding/index.html

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One example is a transfer project on OLED technology in which the University of Augsburg and lighting manufacturer Osram are jointly researching ways of increasing the energy-efficiency and operating life of this promising technology. According to the German law, the intellectual property (IP) in academia-industry collaborations belongs to the university, more specifically to the researcher who has invented the technology. If the industrial partner is interested in using the technology for a commercial purpose, it must negotiate with the academia partner the licensing of the IP.

The main beneficiaries of the programme, according to the results from 2015, are research groups, research centres, research training groups, excellence clusters and graduate schools. In terms of main instruments and processes for industry-academia cooperation, it is relevant to highlight that DFG can only fund basic research in a non-commercial setting. A knowledge transfer project represents the furthest reaching option and is characterized by several prerequisites: it must be based on results generated by a previous DFG-funded research project; substantial input by the application partner form industry; topic must be in the pre-competitive range, no non-disclosure agreements; legal matters must be covered by a cooperation agreement approved by the DFG; and DFG will only fund the university part of a transfer project.

In regards to international cooperation, there are no specific programmes funded by the DFG, only for researchers from different regions (e.g. EU and US) that aim at cooperating in research and development.

4.2.3. France

According to the OECD, France is one of the top five economies in the world as measured by GDP, having the second largest innovation system in Europe, just after Germany. Among the several agencies and programmes that exist at the French national level, the project team has selected the French National Research Agency (ANR) for the purpose of this analysis.

4.2.3.1. French National Research Agency (ANR)[76]

The ANR is a public body under the authority of the French Ministry of Research, promoting basic and applied research, technology transfer and academia-industry partnerships with the goal of promoting excellence at both the academic and technological level. It provides funding for project-based research in all fields of science - for both basic and applied research - to public research organisations and universities, as well as to private companies (including SMEs). It has designed and deployed a range of funding instruments to meet the needs of the project-based research community and supports academia-industry collaboration through different channels – amongst which four are presented in the following section. The main beneficiaries of the programme are researchers at the academia level in partnership with private companies.

The ANR Generic Call for proposal

The ANR's main and historical funding channel is the ANR Generic Call for proposal, which is open to all scientific disciplines and types of research, from basic to applied research carried out in partnership with private companies, including SMEs. The scientific and thematic fields targeted by this call are specified in the ANR yearly Work programme with a "societal challenges"-based approach[77]. The Call for proposal supports collaborative research through three instruments: the "Collaborative Research Projects" (PRC) – which is the main ANR funding instrument, the "Collaborative Research Projects involving Enterprises" (PRCE) and the

[76] http://www.agence-nationale-recherche.fr/en/funding-opportunities/current-calls/

[77] In 2016 the 8 targeted societal challenges are: (1) Efficient resource management and adaptation to climate change, (2) Clean, secure and efficient energy, (3) Industrial renewal, (4) Life, health and well-being, (5) Food security and demographic challenges, (6) Sustainable mobility and urban systems, (7) Information and communication society, (8) Innovative, inclusive and adaptive societies, (9) Freedom and security of Europe, its citizens and its residents.

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"International Collaborative Research Projects" (PRCI).

The funding through "Collaborative Research Projects involving Enterprises" supports collaborative projects conducted as partnerships between public research laboratories and private companies, and enabling public research facilities to address new research issues, or address them in a different way, and by enabling companies to access high-level public research to improve their innovation capacities. Project reviewers evaluate the relevance and soundness of the proposal, as well as the ability of the research laboratory and companies involved to formulate shared objectives in terms of competencies, opportunities, and interests generated by research performed.

The funding to "International Collaborative Research Projects" is intended to speeding up and developing collaborations by French researchers with top European and international research teams in key research fields, and projects may be either exclusively conducted by research organisation partners or via collaboration between such organisations and one or more enterprises. The related call for proposals relies on the bilateral agreements concluded by the ANR with counterpart agencies. In 2016, the US was not part of the provisional list of countries concerned by these agreements at the time of the call for proposals' launch. Reviewers involved in the project selection process examine the international character of proposals, appraised not solely on involvement of partners from one or several countries, but also on balanced collaboration and the sharing of competencies, and opportunities to create scientific value. It is also possible to submit a project with one or several foreign teams from any country desired outside of the bilateral agreements under the generic call for proposals process ("Collaborative Research Projects" PRC).

The Carnot Institutes programme

ANR implements the "Carnot Institutes" programme. The programme, founded in 2006 is a very important one, implemented through a competitive call for applications intended to award the Carnot label to public research institutions whose main strategic focus is partnership-oriented research and with proven, high level Research and Innovation competencies. €60 million are dedicated to this programme each year. The label is designed to develop partnership-based research conducted by public laboratories with socio-economic players, primarily industry (from SMEs to large corporations) to serve their needs and foster innovation. In total, 29 Carnot Institutes exist today in a broad range of fields (health, ICT and digital, mechanic, chemistry, agriculture, among others)[78]. The Carnot institutes are rewarded based on their turnover from their activities for the industry. In this scheme, the industry is a customer for the Carnot Institutes. The programme is considered a success since: the contractual relationships between the Carnot institutes and the industry have grown from €120 million to €470 million in the ten years of programme existence. The Carnot Institutes are evaluated every 3 years, for the renewal of their label. The international turnover of the Carnot Institutes is significant and closely monitored by the ANR, according to Mr. Jean-Michel Le Roux, Deputy Head of Department, "Carnot" Programme Officer. The international promotion of this initiative is based on the Carnot Institutes themselves which promote their institute internationally. There are attempts from Carnot Institutes to go international together and they are encouraged to explore this approach. The initiative has been promoted by the ANR to the US National Academy of Science (NAS).

ANR also implements more specific funding, through the "Industrial chairs". This programme allows public and private researchers involved in the Chair to conduct research in strategic priority areas via a strong and lasting partnership, and intends to make the vision, methodologies and experience of private actors available to doctoral or post-doctoral researchers in high-level public

[78] See the list of Carnot Institutes here: http://www.instituts-carnot.eu/en/29-carnot-institutes

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research laboratories. It involves a call for proposals in all research areas on research themes defined from the outset by the public research laboratory(ies) together with their private sector partner(s). The project must be led by an eminent scientist (holder of the Chair), carried out in one or more public research laboratories, and jointly funded by ANR and the partner company(ies). The ANR funding is provided for up to 48 months and matched with funding from the private companies. This call is also open to international collaboration.

The funding to International Collaborative Research Projects is intended to speeding up and developing collaborations by French researchers with top European and international research teams in key research fields, and projects may be either exclusively conducted by research organisation partners or via collaboration between such organisations and one or more enterprises. The related call for proposals relies on the bilateral agreements concluded by the ANR with counterpart agencies. In 2016, the USA were not part of the provisional list of countries concerned by these agreements at the time of the call for proposals' launch[79]. Reviewers involved in the project selection process examine the international character of proposals, appraised not solely on involvement of partners from one or several countries, but also on balanced collaboration and the sharing of competencies, and opportunities to create scientific value. It is also possible to submit a project with one or several foreign teams from any country desired outside of the bilateral agreements under the generic call for proposals process ("Collaborative Research Projects" PRC).

In addition to the ANR initiative, it is also relevant to mention briefly the Bpifrance Inno generation (BIG) and *the Aide au partenariat technologique* (APT) programmes, which also support the development of academia-industry cooperation in the country.

4.2.4. Portugal

In recent years, Portugal has been witnessing an increase in the level of human capital, as well as enhanced industrial innovation and entrepreneurship actions. Portugal has adopted a new programme in 2011 (Portugal 2020) that focuses in business RDI and innovation, where the business part plays a major role in innovation actions. One of the main Portuguese entities that promotes investment in innovation is Portugal Ventures.

4.2.4.1. Portugal Ventures[80]

Portugal Ventures is a Venture Capital firm, focusing its investments in innovative, scientific and technology-based companies (mainly start-ups) as well as in companies from the more traditional Portuguese Tourism and Industrial sectors, with significant competitive advantages and export oriented to global markets. Portugal Ventures partners with exceptional entrepreneurs, assisting them in achieving new levels of competitiveness and success at all stages of development of their companies and operating in a number of different sectors. In particular, Portugal Ventures has a specific programme that perceived specific agreements with incubators and universities, supporting projects that come from these two entities.

In terms of a quantitative analysis, Portugal Ventures measures its activities through human resources – in total, one and a half man-days are used for this specific programme – Call for entrepreneurship[81]. As previously mentioned, Portugal Ventures invests in start-ups with a technology factor. Portugal Ventures invests in start-ups that are born from research at the university level (pharmaceutical sector for example). This is done through a close relationship and agreements with incubators and technology

[79] See ANR Work Programme 2016. The countries concerned were: Germany, Austria, Brazil (Pernambuco and Sao Paulo states), Canada, China, Hong Kong, India, Japan, Luxemburg, Mexico, Singapore, Switzerland, Taiwan and Turkey.
[80] http://www.portugalventures.pt/en
[81] http://www.portugalventures.pt/pt-pt/page/call-entrepreneurship

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centres within the universities. In addition, Portugal Ventures also develops the Industry 4.0 Call, a new investment programme aimed at entrepreneurs and companies with the purpose of promoting the creation of business and university start-ups and spin-offs within the Industry 4.0 concept, thus contributing in accelerating the development and modernisation of the domestic industry, making it more productive and prosperous, efficient, flexible and globally competitive. The main beneficiaries of the programme are start-ups or project ideas that are associated with incubators and universities, or other innovation ideas that can go from the research area to the market.

As previously mentioned, the programme normally perceives that the product goes from a prototype stage to a final market product. The calls are open to proposals through the Portugal Ventures website and are evaluated by external experts that have expertise in the specific business topic. Regarding the monitoring process, the financed organisations include a member of the board from Portugal Ventures that monitors and supports the business development. Regarding the international dimension, Portugal Ventures' selection criteria for funding is always related with an international component. Particularly with the US, Portugal Ventures holds a space in San Francisco and Boston that serves as a physical space for the funded projects, as well as a high specialized contact network that can support in an initial market approach.

4.2.5. Sweden

In recent years, Sweden has significantly increased the government funding for RDI. In particular, RDI investments done by the industry are concentrated in large firms, which are highly internationalised. Among the different organisations that promote STI projects including academia-industry cooperation, it is relevant to highlight Vinnova and the Swedish Knowledge Foundation (SKF).

4.2.5.1. Vinnova[82]

Vinnova is a funding agency from Sweden aiming at supporting collaborative research and therefore RDI initiatives/programmes in which academia and industry cooperation. Vinnova has an annual budget of €300 million.

All the programmes established and funded by Vinnova require collaboration between academia and industry. For Vinnova, the involvement of industrial partners is crucial to the success of the projects as these are more aware of the industry technology and knowledge gaps.

The academia-industry projects consist in either 6-month feasibility studies or 10 years' programmes. Each academia-industry programme receives as an average a financial support from Vinnova of €4.5 million. Projects are monitored through an intervention log (to follow-up the progress of the projects) and a bi-annual report to analyse the impact of the project outcomes. In terms of international cooperation in Vinnova, there are bilateral programmes where Sweden cooperates with other regions of the globe, such as China, India, Brazil and Japan.

4.2.5.2. Swedish Knowledge Foundation (SKF)[83]

SKF is the research financier for universities with the mission to strengthen Sweden's competitiveness. The aim of the foundation is to help the universities build internationally competitive research environments, work long-term on strategic profiling and increase the cooperation between academia, industry and institutes.

[82] http://www.vinnova.se/en/
[83] http://www.kks.se/om/SitePages/In%20English.aspx

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Since its foundation in 1994, SKF has supported over 200 projects with approximately €1.2 billion of funding. Initially the funding was from the government, but currently SKF is autonomous and the funding is generated through stock exchanges. The projects can amount from €50,000 to €4.5 million. The ones ranging from €50,000 to €400,000 often last from 1 to 3 years, whereas the large projects amounting to up to €4.5 million have a length of 6 to 8 years.

Industry can cooperate with academia by either providing RDI human resources to work with researchers in academia or taking part in research projects. Although the SKF programmes only finance universities, at least two different companies based in Sweden must take part of the project to ensure that the knowledge/technology generated is valuable for the industry as a whole.

The programmes of the foundation therefore are characterized by a long-range view and requirements for co-production with industry. There are four criteria which are crucial to the approval of the project and are monitored throughout the project: the scientific quality of the knowledge generated, the existing benefits to the industrial partners, the accomplishment of the project milestones and the implementation/ management capacity of the project team.

4.2.6. Czech Republic

According to the Research and Innovation performance profile of the H2020, Czech Republic has reached the EU average in terms of RDI intensity and recent progress has been made. However, there is still weak cooperation levels between public research and industry. In this sense, within the main agencies promoting academia-industry cooperation in the country, CzechInvest was selected.

4.2.6.1. CzechInvest[84]

CzechInvest is a Business and Investment Development Agency from Czech Republic. The agency belongs to the Czech Republic Ministry of Industry and Trade and, since its establishment in 1992, it contributes to attracting foreign investment and developing domestic companies through its services and development programmes. CzechInvest also promotes the Czech Republic abroad and acts as an intermediary between the EU and small and medium-sized enterprises in implementing structural funds in the Czech Republic.

There are two main types of financial support from the EU used in CzechInvest, for promoting international academia-industry cooperation: the European Structural Funds and the H2020 Programme funds. The European Structural Funds supports hundreds of RDI projects in which, in some cases, researchers from the EU and the US participate and work together. Financial support ranges typically from €100,000 to €500,000. The H2020 Programme funds joint academia-industry projects of €1 million.

CzechInvest advises on applying for: national funds from the Ministry of Industry and Trade dedicated to Programmes to be developed and implemented in Czech Republic; The EU funds dedicated to Programmes aiming at accelerating the innovation in several industrial sectors; and private funds which primarily consist in venture capital and financial support from the industry for RDI Programmes. Besides funding, CzechInvest also help investors from the industry to find the most indicated partners for RDI projects.

The projects, sometimes between the EU and the US, often last 2-3 years. A significant fraction of the academia-industry projects funded by the European Structural Funds and the Horizon 2020 Programme are in the IT (e.g. cyber) and aerospace industrial

[84] http://www.czechinvest.org/en/financial-support-programmes

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sectors, particularly in the case of projects in which it is established an academia/industry collaboration between the EU and the US. CzechInvest is exclusively authorized to file applications for investment incentives at the competent governing bodies and prepares draft offers to grant investment incentives. Its task is also to provide potential investors current data and information on business climate, investment environment and investment opportunities in the Czech Republic.

Operational Programme Enterprise and Innovation for Competitiveness (OP EIC) 2014 – 2020 is the successor of the OP Entrepreneurship and Innovations in the programme period 2007 – 2013. European Regional Development Fund allocated approximately €4.3 billion for the projects within the OP EIC. Managing authority (Ministry of Industry and Trade) delegates the majority of the implementation-related tasks to CzechInvest, which serves as a primary intermediary for the financial support and is responsible for communication to aid applicants and recipients. The communication is conducted through ISKP 2014+ (the information system for aid recipients). ISKP 2014+ serves for all operational programmes on the national level in the programming period 2014 - 2020. Although the grants are the main form of support, there is intention to provide, where appropriate, support in the form of the financial instruments (advantaged loans, guarantees and venture capital) or in the combined form. Small or medium-sized enterprises are eligible to receive aid within OP EIC, though in some programmes large enterprises can also apply for aid. However, projects must be implemented within the Czech Republic, outside the City of Prague (the seat of the company can be located anywhere in the Czech Republic)[85].

In terms of international cooperation, CzechInvest has a crucial role in establishing cooperation between academia and industry entities from different zones of the globe. The establishment of this cooperation is supported by CzechInvest through two main ways. The first consists in the facilitation of missions for companies from Czech Republic to find RDI or industry partners outside Czech Republic. The EU-US cooperation stabilised during these missions is often industry-industry collaborations as the main aim of companies is to promote their internationalisation by entering the US market. The second corresponds to advising companies from Czech Republic on how to leverage EU funds aiming at promoting international cooperation between academia and industry.

[85] http://www.czechinvest.org/en/operational-programme-entrepreneurship-and-innovations-for-competitiveness

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5. EU-US ACADEMIA-INDUSTRY COLLABORATION SCHEMES – COMPARE AND CONTRAST

5.1. Overview

This section discusses the main collaboration schemes identified in the two previous sections regarding the US and EU programmes for supporting academia-industry collaboration.

Regarding the US, five departments at the US Federal level (in total 16 programme opportunities) are analysed and four programmes are analysed at the State and university level. At the EC level, five Directorate-Generals (DGs) and two Agencies are analysed, including five programmes for academia-industry cooperation. At the EU MS level, five countries and seven programmes are analysed.

As previously described in the methodology, the project team provides a balance between the number of US and EU programmes presented, as well as in the thematic areas of each. From the US side, the department areas analysed at the Federal level are as follows: Department of Defense, National Science Foundation, National Institutes of Health, Department of Commerce, and the Small Business Administration. At the State level, the Deliverable presents some state and regional programmes and university coordination examples. These are a key feature of the US funding system, supplementing sometimes the funding provided at the Federal government level. In terms of the EU DGs, the following are analysed: DG Research and Innovation; DG Health and Food Safety; DG Energy; and DG for Internal Market, Industry, Entrepreneurship and SMEs. In addition to the main DGs, there are also executive agencies at the EU level that are responsible for executing parts of funding programmes – such as the Executive Agency for Small and Medium-sized Enterprises (EASME) and the Innovation and Networks Executive Agency (INEA). These executive agencies are relevant due to their high budget values and range of thematic areas. Regarding the EU MS level, the funding available is lower than the available at the EC-level. Compared to the US, MS level funding programmes do not have the same representativeness as the ones that are available at the State level.

5.2. Main differences between the EU and US collaboration schemes

This analysis allows one to compare and contrast the main differences between the EU and US collaboration schemes, taking into consideration their funding structure, the application process and the international dimension. Through this analysis, the project team is able to provide a set of potential opportunities for further international cooperation between the EU and US. Table 2 presents the main differences between academia-industry programmes in the EU and in the US.

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Table 2 – Main differences between academia-industry programmes in the EU and in the US

		EU	US	EU vs US
Funding	*Centralisation of funding*	In several cases at the MS level, the funding available for university and industry players is in many cases provided by governmental agencies that receive funding from the EC (e.g. funding available through Portugal 2020 programme). In these cases, the areas and research topics that are funded are balanced in line with the priorities established at the EU level. However, the innovation funding agencies also have their own funding budget that is originally from national funds.	The US STI funding system is highly decentralized, with support schemes at the US Federal, state and regional level. A key characteristic is that significant funding flows down from the US Federal level to state and regional institutions. These institutions will often employ Federal resources, in combination with their own contributions, to meet state and regional goals. In other words, in the US funding system, the majority of funds come from a few Federal sources, but are adapted to a variety of goals by institutions at the state and local level.	While the EU sets research priorities, only US Federal funds in basic science (i.e. largely NSF and NIH) cut across all disciplines. Other US Federal funding for R&D is aligned with agency missions. At the US Federal level, innovation is an important focus of the Commerce Department, but aligned around the goals of grantees at the state and regional levels. State and regional institutions are more familiar with, and close to, the needs of the business sectors that comprise the regional economies[86].
	Origin of funding	At the EU level, the majority of funding is provided through the EC (public). At the MS level, the funding is mainly provided through governmental agencies (such as Vinnova), and in some cases by private entities (such as SKF). There is also the case of joint venture capital funding available at the MS level (such as programmes from Portugal Ventures), although the majority of academia-industry cooperation funds are available through public entities.	Overall, US Federal funding is provided through the governmental departments and agencies, although there are some cases of joint funding. For example, the ERC's are allowed to receive supplemental funding from corporate partners and a significant amount of an IUCRC's financial support is expected to come from industry, state and other funds.	The EU provides funding through the EC (DG RTD, DG SANTE, etc.), and the MS through ministries, funding agencies and other institutional arrangements. In the US Federal system, funding is provided through agencies, with a wider range of sources at the state and local level. In both cases, the origin of funding becomes more diversified at lower levels of government.

[86] INNO Policy TrendChart: Mini Country Report/United States of America: http://ec.europa.eu/enterprise/policies/innovation/files/countryreports/usa_en.pdf

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		EU	US	EU vs US
	Budget	The budget available at the EU level is normally superior in comparison to the budget available at the MS level. For example, the H2020 has a budget of 80€ billion between 2014 and 2020, and the SME Instrument has a budget of €3 billion between 2014 and 2020. This is also the case at the project level (e.g. projects within Portugal 2020 programme have lower budgets than the ones in H2020). At the MS level, the budget depends on the country. For example, DFG has a high budget (€2.9 billion in 2015), but Vinnova has a lower one (€300 million). Nevertheless, around 80% of total RDI spending in Europe is financed at the MS level.	US Federal STI spending is very large. While DoD spends about $75 billion annually on RDI alone, total spending at the key agencies of DoE, NIH, NASA and NSF range from $7.5-$33 billion annually. Funds are distributed across a large number of programmes (e.g. NIH's $31.3 billion budget in 2016 supported approximately 35,000 research grants and contracts and more than 300,000 researchers). In comparison, state and regional spending is just a few billion across all 50 states (e.g. since 1984, NCBiotech has distributed more than $16 million in state money to about 90 companies). However, very little of the Federal effort even indirectly targets academia-industry collaboration, whereas state initiatives are more focused, with specific business sectors in mind.	The US Federal government provides most of the funding for STI, for executing agency missions. However, a stream of funds does flow down to states and regions, where sometimes it is combined with local sources. In the EU, funding from the EC is the most important, but is complemented by significant support from some MS. At the MS level, the funding comes from governmental and public institutions that in many cases are financed by the EC, following its guidelines.
	Type of Funding	The majority of funding is provided through the EC in the form of grants and public contracts (tenders). The funding is mainly public with some cases of in-kind requirements. In cases such as the SME Instrument, the financing is divided (EASME finances 70%, 30% from SMEs). At the MS level, funding is granted through governmental institutions or private entities in the form of grants, loans, vouchers, tax incentives and consulting services, with the investment normally provided partially by the institution and the applicant. In addition, there are cases (such as the DFG) where the financing corresponds to half of the investment required for the project execution – other half is supported by industrial partners.	The majority of funding is provided through grant programmes, although contracts (subject to closer oversight and terms and conditions) are also used (in particular by DARPA and ARPE-e). In terms of type of funding available, this depends on the different agencies, departments and institutes in question (e.g. NSF prefers to fund multi-university to single-university). There is also the case at the state level involving investment in venture capital funds (e.g. North Carolina Biotechnology Center-NCBiotech). State support schemes in general have a narrow focus on the state's assets and priorities, and align funding from the Federal government level accordingly.	At both the EC and US Federal levels, the main type of funding is primarily provided through grant schemes (also public tenders in the case of the EC). At the EU MS level, the funding is provided through public or governmental institutions, also in the form of grants, and normally support by the institution and partially by the applicant. At the US state level, the funding is normally aligned with state economic goals.

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		EU	US	EU vs US
Application Process	*Academia motivation*	Overall, in universities and research institutes, it is more difficult to cooperate with the industry as they are afraid of losing IP rights. In Germany, this does not happen because the German law states that IP in academia-industrial collaborations belongs to the university, more specifically to the researcher who has invented the technology. In addition, universities are normally very engaged in EC funding schemes (the first results of the H2020 show that universities are the top and most successful applicants in terms of type of organisation).	Academic researchers look first for support from Federal sources because there are fewer constraints, but they are increasingly inclined to seek support from businesses as Federal funding has declined while business RDI continues to grow. Universities serve not only as sources of innovative ideas because of their mission, but also assist and administer the innovation processes through licensing, technology transfer, incubation and spin-offs to earn independent revenues (although the levels achieved by most institutions are still relatively minor). Negotiating IP rights with business is harder than with the Federal government (which is very permissive because of the Bayh-Dole Act), but the major RDI institutions are experienced and successful.	The majority of the academia side in both the EU and the US have experience in funding schemes at EC and US Federal and state levels respectively. Although in the US, direct support from business is growing. Regarding IP rights, some issues are found at the EU and US Federal level, although the issues seem more significant at the EU level.
	Industry motivation	Companies in the industrial sectors which are more at the competitive edge, such as the engineering and machinery sectors, are reluctant to cooperate with academia as they would prefer to have the complete control of the knowledge and technology of their industrial products. Companies do not apply to projects in which there is a high risk of not implementing the technology/knowledge developed in the project.	Industry seeks to strengthen its competitiveness and obtain competitive advantage and new knowledge, particularly at the technological level. In CTAs, the alliances (industrial research laboratories and universities that team together) are set up through cooperative agreements for core research with task order contracts to facilitate technology transition. Typically, industry leads these efforts. While technology as a source of competitive advantage is important, talent is also equally valuable. Many businesses enter into joint projects with universities in order to gain access to new, talented human resources.	It is critical to stress that in the US the industry undertakes the heavy burden of innovation performance (unlike in most European countries where innovation performance very much relies on universities and public research organisations). In the US, industries are much more engaged with universities in terms of recruiting relevant resources, although this is also growing in the EU. It must be noted that in Germany, more than half of the total RDI expenditures are spent in the business sector[87].

[87] Report on the EU & US innovation policy framework and relevant initiatives, BILAT USA 2.0 (2015)

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		EU	US	EU vs US
	Application length	The application process is relatively balanced in the EU: both at the EU level and MS level.	US Federal applications take some time, and require experience with US Federal contracting procedures, which operate as a de facto obstacle to international partners. Nevertheless, complete applications for Federal programmes can be done in less than three months, and grants are often awarded within three months of the submission date.	The process to access public funds is 4 to 5 times longer in the EU than in the US, according to one of the interviewees from H2020.
	Application complexity	Funding is managed according to strict rules which help to ensure that there is tight control over how funds are used and that funds are spent in a transparent and accountable manner. EU funding is complex, since there are many different types of programmes managed by different bodies.	Each funding opportunity among the different departments and agencies includes different needs and requirements, but normally a set of pre-requisites or registrations are needed. For example, the NIH will accept electronic applications only from organisations that have completed all necessary registrations. Applications are submitted online, mainly through the "grants.gov" website or through agency-specific submitting system.	The EU and US have similar complexities in regard to the application process. Each department or institute has different requirements and different online systems for proposal submission.
	Success rate	Success rate of project proposals vary by department or agency. For example, the first results of the H2020 indicated that it had a success rate of 14%. As a result, the industry needs to ensure that the resources used to generate the proposal are compensated by the impact of the knowledge and technology developed at the end of the project.	Success rates of proposals vary widely, with proposals to NIH and NSF ranging from as low as 10% to about 25%. There is significant variety across disciplines. DoD and DoE grants tend to have slightly higher success rates.	It is too difficult to determine a difference in success rates between the EU and US since the rate varies by government entity, by agency, by programme, etc. It appears the success rate is between 10 and 25% in most cases.

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		EU	US	EU vs US
International Dimension	*Openness*	Funding agencies are less open to fund projects with international partners (outside the EU) as the main aim of the academia-industry programmes is to increase the competitiveness of European industry. Nevertheless, programmes funded by the H2020 are eligible to several 3rd countries[88]. The openness to international involvement at the MS level varies according to the specific country. For example, in DFG, there is only direct funding for researchers from different regions (e.g. EU and US). In addition, in Vinnova, there are bilateral programmes where Sweden cooperates with other regions of the world, such as China, India, Brazil and Japan. For Austria, there is the Beyond Europe Programme that specifically supports international collaboration.	There are several programmes that are open to international cooperation – either through direct participation, or through cooperation actions (e.g. MRSEC promotes active collaboration between universities and other sectors, including industry, national laboratories, and international institutions). Generally, the level of transparency at the US Federal level is very high if the applicant has experience navigating the government procurement system, which is somewhat cumbersome. It is relevant to note that it is considered rather difficult for citizens of other countries to get detailed information regarding the application process for US to state level funding schemes.	US support schemes are not as open as the ones at the EU level. In particular, under H2020 there are opportunities that mention specifically the US cooperation, and where this is a requirement.
	Funding for international parties	No funding for US organisations: US must finance themselves as most EU funds do not support industrialised countries – for instance, under the H2020 Programme. Nevertheless, there are cases where specific cooperation with the US is perceived (in specific calls for proposals). In terms of the MS level, there are cases were funding for international parties is available. For example, in Austria, FFG funds international partners in up to 20% of the total requested project budget.	There are some entities that provide relevant funding programmes for international cooperation at the US Federal level (such as the NIH and DoD). In general, no agency is opposed to unfunded international collaborators (except, of course, in the case of classified programmes), but no agency, except in a very few cases, makes a special effort to target international partners. If international partners learned the complexities of the system, they would generally be on a level playing field.	The direct funding from the EU side exists in specific opportunities or programmes. There are more funding opportunities for US organisations through EU support programmes than otherwise. However, the focus should be on joint coordinated calls from each side, receiving funding from their respective country organizations.

[88] Iceland; Norway; Albania; Bosnia and Herzegovina; the former Yugoslav Republic of Macedonia; Montenegro; Serbia; Turkey; Israel; Moldova; Switzerland (partial association); Faroe Islands; Ukraine; Tunisia; Georgia; Armenia.

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6. EU-US ACADEMIA-INDUSTRY COLLABORATION GOOD PRACTICES EXAMPLES

6.1. Overview

This section showcases some examples of good practices at the US Federal level, EU level and MS level. As indicated by several interviewees, both the academia and industry benefit from enhanced collaboration actions between the two parties. The examples described in this section assist in the understanding of different scenarios of cooperation and highlight best practices for the further development of EU-US academia-industry collaboration actions. The universities can provide major resources in terms of a company's innovation strategy. In this sense, it is relevant to take into consideration the concept of Open Innovation referring to "combining internal and external ideas as well as internal and external paths to market to advance the development of new technologies"[89]. The rate of change of technology has a large impact on the market. Furthermore, collaborative research is more and more present in the innovation ecosystem, allowing the industries to more easily obtain know-how and talent and the academia actors to commercialize their research results. However, some obstacles such as IPR policies and lack of trust prevent stronger university-industry collaboration activities in the EU and US.

In addition, it is relevant to assess the main good practices among the different collaboration support schemes described in the previous sections. According to the analysis developed in the previous sections, a successful academia-industry funding programme should have a well-defined, concise and clear mission statement, support the mission statement while accounting for the context of the relevant regions, clearly define the limits of the programme (if this is regional, national and/or international), and identify the eligible fields of research and eligible organisations and/or individual backgrounds. In terms of the selection process, the programme should define some criteria for project selection (researcher track record, technical merit of the proposal, diversity of the consortium, etc.), provide proposal review results to the submitter in order to give credibility and value to the process and provide a transparent process to establish credibility. Furthermore, the programme should be able to establish an effective ongoing process of monitoring the results and impact of projects. Based on this assumption, inputs from the interviewees were gathered and analysed, including specific suggestions of best practices, leading to the development of relevant information for selecting three success stories. In this sense, three examples of good practices are highlighted in this section according to the following selection criteria:

- Projects that are supported/included within one of the departments or agencies programmes analysed under Section 3 and Section 4.
- Projects that promote directly academia-industry cooperation through involving both parties – academia and industry should be eligible beneficiaries.
- Projects that have some international dimension (in particular between the EU and US).

Taking into consideration the selection criteria defined and the analysis developed in the previous sections of this Deliverable, the following three success stories are highlighted:

[89] Chesbrough, Henry, Open Innovation: The New Imperative for Creating and Profiting from Technology" (2003)

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- Success Story 1 (US Federal level): International Technology Alliance in Network and Information Sciences.
- Success Story 2 (EC level): BIOactive implantable CApsule for PANcreatic islet immunosuppression free therapy (BIOCAPAN) project.
- Success Story 3 (US-EU joint funding): Center for Visual & Decision Informatics (CVDI).

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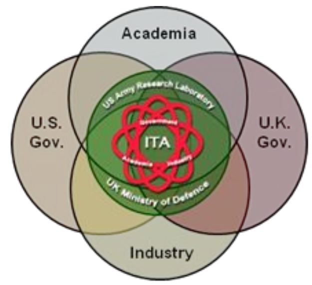
6.2. Success Story 1 (US Federal Level): International Technology Alliance in Network and Information Sciences

International Technology Alliance in Network and Information Sciences

Website: http://nis-ita.org/
https://www.arl.army.mil/www/default.cfm?page=77

Duration: May 2006 – May 2016

Type of initiative: US Army Research Laboratory Program



Relevance: The project is an example of how the US Department of Defense (DoD) and the U.K. Ministry of Defence (MoD) supports collaboration among government, academia and industry, through a bilateral agreement.

Beneficiaries: Large businesses, universities, and defence departments in the US and UK

- Private sector, academic, and government scientists and engineers with expertise in the network and information sciences
- Companies and universities with presences in either the US or UK

Context: The International Technology Alliance in Network and Information Sciences (NIS-ITA) integrated the US Army Research Laboratory (ARL) and the UK Defence Science and Technology Laboratory (Dstl) with a consortium of 24 leading academic and industrial organisation from the US and UK with deep expertise in the fields of network and information science in order to jointly conduct fundamental research in the context of coalition operations.

Objective(s): NIS-ITA was launched with the strategic goal of producing fundamental advances in network and information sciences to enhance distributed, secure and flexible networks for information delivery and decision-making in future coalition operations. NIS-ITA research focused on issues relating to network theory; security across a system of systems; sensor information processing and delivery; and distributed coalition planning and decision-making.

Support to the beneficiaries: $92 million over the course of the NIS-ITA lifetime, in addition to collaboration management and coordination support provided by ARL and Dstl.

International dimension: The NIS-ITA consortium was co-led by IBM Research in the US and IBM Emerging Technology in the UK. The highly successful collaborative research programme ultimately involved over 850 researchers from 160 organisations spanning 25 countries.

Results/outcomes: A senior independent peer review identified NIS-ITA as "an outstanding example of true, deep and enduring International Research Collaboration" that has "…significantly advanced the state-of-the-art in network and information science through multi-disciplinary research...". The existing research interests and expertise of the bilateral, multi-organisation, inter-disciplinary NIS-ITA partners brought a sharp focus to the programme and enabled different skills from academia, industry, and government to be used together to great effect. The NIS-ITA illustrated how the application of synergistic combinations of network and information sciences to network centric warfare and network enabling capabilities could support of a range of military missions including humanitarian support, peacekeeping, and full combat operations in any kind of terrain, but especially in complex and urban terrain. The alliance also stimulated dual-use applications of its research and technology to benefit commercial use.

Relevance to the report: The project involves academia and industry actors from the US and the EU. In addition, the project includes the participation of key players from the industry and research side. The cooperation is a good example of long-standing cooperation between academia-industrial players from both regions.

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6.3. Success Story 2 (EC level): BIOCAPAN Project

BIOactive implantable CApsule for PANcreatic islet immunosuppression free therapy (BIOCAPAN)	
Website: http://www.biocapan.eu/	BIOCAPAN
Duration: 2015 – 2019	
Type of initiative: Horizon 2020	

Relevance: The project provides EU funding to a US organisation (Wake Forest University Health Sciences (WFUHS)), with a significant value – €765.000 funding to the US partner. The project consortium involves both industry and academic partners.

Beneficiaries: The project brings together a multi-disciplinary international team of experts from France, Germany, Spain, Norway, Belgium and the US.

Context: Funding under the EU Horizon 2020 (H2020) programme call H2020-NMP-2014-two-stage.

Objective(s): The project aims to develop an innovative Good Manufacturing Practices (GMP)-grade cell-therapy product, to treat diabetes without insulin injections and immunosuppressant administration. The project is based on the implantation of smartly microencapsulated allogeneic islet cells, which will allow an effective long-lasting blood glucose level normalisation and stabilisation without the need for immunosuppressants. This treatment would be appropriate for all type I and about one in six type II diabetes mellitus patients – about 80 million people worldwide.

Support to the beneficiaries: €8 million of EU contribution to the project partners, including €765.000 funding to a US partner.

International dimension: The international dimension is related first with the consortium partners, which brings together a multi-disciplinary international team of experts from France, Germany, Spain, Norway, Belgium and the US; and, second to provide a worldwide solution to develop an innovative GMP-grade cell-therapy product, to treat diabetes without insulin injections and immunosuppressant administration.

Results/outcomes:

- Delivering a specification file for the development of all the microcapsule compounds and their in vitro and in vivo assays, and submitting the Clinical Trial Authorization dossier to the regulatory agency.
- Ensuring that all the product development steps will be compliant with regulatory requirements.
- Providing the optimal composition of the bioactive BIOCAPAN microcapsule and planning for GMP production of all capsule components.
- Producing a GMP compatible microfluidic platform for standardized bioactive microcapsule production.
- Producing a GMP encapsulation process procedure with defined quality controls for intermediate and final products ensuring identification, safety and functionality of the final products.
- Validating the in vitro functionality and viability of encapsulated islets and the biocompatibility of the BIOCAPAN biomaterials and microcapsules.
- Implementing preclinical models to validate the GMP-grade bioactive microcapsule.

Relevance to the report: This is a high-value funded project that involves different target groups (big companies, SMEs, universities and research centres), which allows for RDI actions to have a higher impact on the industry. Thus, this case study illustrates that including key players from the industry side is important.

6.4. Success Story 3 (US-EU joint funding): Center for Visual & Decision Informatics (CVDI)

Center for Visual & Decision Informatics (CVDI)

Website: http://www.nsfcvdi.org/

Duration: Founded in 2012

Type of initiative: CVDI is currently in Phase I of the Industry-University Cooperative Research Centers Program (IUCRC) funded by industry members and the NSF. Tampere University of Technology also receives funding from TEKES.

Relevance: Multi-university – industry research centre that promotes high-quality industry relevant research and direct technology transfer of ideas, research results and technology to the US industry, receiving funding from both the NSF and TEKES.

Beneficiaries: University of Louisiana at Lafayette and Drexel University. In 2014, the centre added an international academic partner site Tampere University of Technology in Finland.

Context:

Consortium of researchers and students across multiple universities to advance research and innovation in big data with respect to Internet of Things – specifically how large scale multi-dimensional datasets are analysed and interpreted using advanced data mining, and visual and perceptual techniques for decision makers. It also involves partnerships with relevant industry members.

Objective(s): CVDI's mission is to research and develop next generation visual and decision support tools and techniques to enable decision makers in government and industry to fundamentally improve the way their organization's information is interpreted and analysed. CVDI brings together, analytic, visual and perceptual techniques by advancing the state-of-the-art in the research fields of Information Visualization, Visual Analytics and Automated Analysis.

Support to the beneficiaries: CVDI received more than $5.1 million in funding since 2012 from industry members, the NSF and TEKES[90].

International dimension: The proposed centre activities will enhance the international competitiveness of the American industry in the problems and opportunities of leveraging data for evidence-based decision support. The centre combines two universities from the US plus a European university from Finland. In addition, CVDI receives funding from industry partners (besides the NSF and TEKES).

Results/outcomes:

- The centre also intends to promote, catalyse, and accelerate the commercialization of technology innovations.
- CVDI completed 25 research projects that developed next-generation technologies that help industry members improve the process of analysing and interpreting large volumes of data.

Relevance to the report: It provides a good practice example of joint funding projects (from both US and EU MS agencies) that promote industry-academia cooperation on a long-term basis.

[90] http://www.ucs.louisiana.edu/~nrg0821/projects.html

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6.5. Good Practices Analysis

The examples provided in the previous sub-sections allow to have a detailed description of specific cases of academia-industry collaboration, and in particular their openness for international cooperation. In this sense, an analysis on the examples highlighted is developed, combining the results of the three success stories, as well as the research conducted in the previous sections of the Report.

In total, three success stories were highlighted taking into account the desk research and interviews developed with relevant programme owners of academia-industry collaboration support schemes. In this sense, these examples demonstrated that successful cooperation, including between the EU and US, is influenced by several factors, in particular:

- Diversity and size of the project consortium: The examples described show many differences in terms of the consortium size for academia-industry collaboration actions. In the second success story on BIOCAPAN, the consortium is composed of several partners involving key players from industry and academia. The diversity of the partnership with the inclusion of different relevant players from both the EU and US is considered to be of added value contributing to the project's success. According to the examples, this is more important for the project's success, as key players can enhance the impact on the ecosystem (either at the academia or industry level) and further exploiting the results to other applications. In this sense, for successful applications, the diversity in terms of different types of partners of the consortium is considered a plus, but not a prerequisite for success.
- Involvement of key players from the industry side from both regions: According to the examples described, the involvement of key industry players in the project consortium is regarded as a relevant way to guarantee efficient academia-industry cooperation and increase the chances of transferring research results to the market. For example, the first success story of the International Technology Alliance in Network and Information Sciences involved large businesses, universities, and defence departments in the US and UK as the main beneficiaries. In this sense, this alliance stimulated dual-use applications of its research and technology to benefit commercial use.
- Different types of academia-industry cooperation: As described in the three success stories, there are different methods for developing academia-industry cooperation. The first and second success stories are examples of direct involvement of key industry and academic players in the project consortium from both the EU and US sides, defining the main activities and operations developed under the project. On the other hand, the third success story represents a case of direct funding from both US and EU agencies, as well as industry actors. Both approaches promote the development of efficient academia-industry cooperation actions, leading to the creation of jobs, technology transfer and sustainability. Nevertheless, it is important to further detail the two scenarios of academia-industry cooperation. The first considers the direct involvement of industry and academia players in a project consortium, which allows for a constant interaction and for pursuit of common objectives for both sides, leading to collaboration actions (e.g. the BIOCAPAN Project). Regarding the second type of cooperation concerning the involvement and integration of university graduates in industry activities, this cooperation can promote integrated learning between the two parties – for the industry, the students can have an opportunity to apply new methods and innovation actions in the organization, while the organization can encourage the graduates to come with new ideas that enhance their business objectives. In the case of EU-US cooperation, this could be a starting point to better understand the market of each region and develop new contacts for collaboration projects.

The three success stories provide different examples of academia-industry international cooperation, with distinct cases of how

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collaboration can occur. Different levels of openness to international levels are verifiable depending on the funding scheme and specific STI activity perceived. In addition to the good practices taken from the success stories, some good practices in university-industry collaboration have also been identified by the interviewees. In particular, the interviewees highlighted that joint publications between public and private communities can serve as a good method for promoting academia-industry cooperation, especially for developing new prototypes. Furthermore, it is suggested to continue the incentives that exist, bringing more people into the innovation process, particularly by changing the mindset of the innovation students, as well as mobility actions, which are considered a plus.

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7. CONCLUSIONS AND RECOMMENDATIONS

The aim of this report was to explore relevant academia-industry funding programmes available at the Federal and State levels (on the US side) and at the EC and MS levels (on the EU side). For developing this analysis, a set of interviews with 10 relevant programme owners from the US and 10 from the EU were performed, as well as an in-depth desk research on the existing funding schemes and opportunities. From the US side, the project team analysed some of the most important departments and agencies, in particular the DoD, DHHS, NIH and NSF. On the other hand, the Deliverable provides an analysis on the state and regional support schemes, namely the NCBiotech, the MIPS, the CMU and the Georgia Institute of Technology Office of Industry Collaboration. From the EU side, several DGs and Executive Agencies were analysed, in particular the DG RTD and the DG SANTE, as well as the INEA and the EASME. At the EC level, the Deliverable reveals that the majority of academia-industry cooperation support schemes are framed under the H2020, both in terms of budget and number of open opportunities in different thematic areas. The Executive Agencies are also important in this process, as these execute a considerable part of the H2020 programme (e.g. INEA). In addition, the Deliverable provides an analysis at the EU MS level, assessing the academia-industry collaboration support schemes in Germany, France, Sweden, Portugal and Czech Republic. At the EU MS level, the funding available is lower than the one available at the EU-level, and normally is provided through governmental agencies that receive funding from the EC.

Analysis of US and EU academia-industry collaboration support schemes

The assessment of the US and EU academia-industry collaboration support schemes provided the basis for developing a comparative analysis on three main areas: the funding structure, the application process and the international dimension.

- The funding structure at the EU side is mainly provided through the EC, primarily the DG RTD, and the MS through ministries, funding agencies and various institutional arrangements. In the US Federal system, funding is provided through agencies, with a wider range of sources at the state and local level. In both regions, the origin of funding becomes more diversified at lower levels of government. In the US, funds flow down to states and regions, where it is sometimes combined with local sources. In the EU, funding from the EC is most important, but is complemented by significant support from some MS. In most European countries funding from the private industry is not as prominent. More balance would be needed at the EU side, allowing an increase on cooperation opportunities between both regions. In addition, the lack of uniform international standards can limit new innovative technologies and cooperation opportunities in a variety of markets.
- The application process is considered to be relatively balanced at the EU and MS level, being somewhat complex, since there are many different types of programmes managed by different bodies. On the US side, each funding opportunity among the different departments and institutes has different needs and requirements. Nevertheless, it is normal that a set of pre-requisites or registrations are needed beforehand. Regarding the success rate of the proposals submitted, this is dependent on the department or agency that manages the programme. At the EC level, the first results of the H2020 indicated that the success rate was around 14%; while at the US level, NIH had a success rate of around 20% in 2015 and NSF had around 23% of successful proposals in 2014.
- The international dimension of both regions is somewhat limited, each for different reasons. At the EU level, funding agencies and programmes are less open to fund projects with international partners (outside the EU) as the main aim of the academia-industry programmes is to increase the competitiveness of European Industry. Nevertheless, the H2020 supports the eligibility of several countries outside the EC, including the US (under certain requirements). At the MS level,

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it is more difficult to find relevant programmes that provide eligibility to US organisations, although some programmes promote collaboration action at the project stage. For the US side, there are some entities that provide relevant funding programmes for international cooperation at the Federal level. However, few agencies, except in a very select number of cases, make a special effort to target international partners. At the state level, it is considered rather difficult for non-US citizens to get detailed information regarding the application for these funding schemes. Nevertheless, there are several programmes that are open to international cooperation, either through direct participation, or through cooperation actions.

Opportunities for international cooperation for academia-industry actions

Following the analysis developed on US and EU academia-industry collaboration support schemes, the Deliverable identified several opportunities for further improving international cooperation on academia-industry actions between the EU and the US, namely:

- Align thematic areas in both regions, leading to more open opportunities for both regions in topics of mutual interest.
- Develop opportunities that promote international openness in academia-industry participation (e.g. industry player from the US and a university from the EU), with direct eligibility of the participants.
- Facilitate the application process, with explanatory guidelines and entities to support fulfilling the requirements.
- Increase coordination between academia and industry in terms of IPR and trust issues, particularly between the EU and US.

The described opportunities for further improving international collaboration should be addressed by departments and agencies from both regions that promote academia-industry cooperation actions.

In addition, the STI cooperation agreements between the EU and the US are very important for promoting regular policy dialogue and providing an opportunity to develop the international cooperation among the two regions, particularly in the STI field. In addition, twinning programmes from the H2020 are also seen as relevant for RDI collaboration and effort coordination between research institutions, promoting innovation capacity of a specific research field.

Recommendations for further cooperation

Based on the analysis and conclusions developed under this deliverable, a set of recommendations for further improvement of academia-industry cooperation between the EU and US is described below:

- Provision of detailed guidelines on the application for EU and US support schemes that support the direct participation of academia and industry players, in order to promote the development of joint projects.
- Development of specific opportunities for EU and US collaboration for academia-industry projects, perceiving direct eligibility from organisations on both sides – focus should be on the programmes and agencies previously identified under this deliverable.
- Development of information days that provide relevant contributions to potential applicants and that promote networking actions between EU and US organisations. This should be promoted at the EU and US Federal level by the main funding organisations (e.g. H2020 or the NIH). The stakeholders involved in these events should contain players from both the academia and the industry side that are interested in applying to these funds.
- Higher number of short-term joint research projects to provide a foundation for longer-term cooperation relationships between different organisations (universities and industrial players) from both sides.
- Enhancement of coordination between academia-industry programmes to ensure that resources applied during the projects are compensated by enhanced knowledge and technology developed (both at the academia and industry level).

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In this sense, commercialisation of the research results should be a priority for joint collaborations (mainly at the EU side). This process of validating the results would act as a catalyst for enhanced US participation in EU programmes.

- Development of further cooperation agreements between the EU and the US that provide policy guidelines for future collaboration opportunities at the academic and industrial levels, facilitating the development of new actions coordinated by the governments of both sides.

It is relevant to highlight the important contribution provided by the interviewees, in particular for supporting the identification of three success stories, and for providing insight to the recommendations and good practises for developing academia-industry international collaboration projects.

Both the EU and the US have an extensive range of academia-industry collaboration support schemes for the development of innovative projects, with a focus on international cooperation. However, further promotion of coordination actions between regions, in particular towards international openness, is seen as a key factor for developing the STI ecosystem. Furthermore, mechanisms for enhancing trust and overcoming IPR issues would benefit academia-industry projects and therefore promote new cooperation actions between EU and US innovation actors. Subsequent to this report, the project team will organise two good practice workshops on academia-industry collaboration aiming to bring academia and industry actors from the EU and the US together to support international cooperation. This report will be disseminated prior to the workshops and discussed with the participants.

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ABBREVIATIONS

AMNPO	Advanced Manufacturing National Program Office
ANR	French National Research Agency
ARL	Army Research Laboratory
ATE	Advanced Technological Education
BIC	Building Innovation Capacity
BIG	Bpifrance Inno generation
B2B	Business to Business
CAN	Cognition and Neuroergonomics
CEF	Connecting Europe Facility
Chafea	Consumers, Health, Agriculture and Food Executive Agency
COSME	Competitiveness of Enterprises and Small and Medium-sized Enterprises EU Programme
CRA	Cooperation Research Agreement
CTA	Collaborative Technology Alliances
CVDI	Center for Visual & Decision Informatics
DAAD	German Academic Exchange Service
DARPA	Defense Advanced Research Projects Agency
DAIS	Distributed Analytics and Information Science
DFG	German Research Foundation
DHHS	Department of Health and Human Services
DoC	Department of Commerce
DoD	Department of Defense
DoE	Department of Energy
DSTL	Defence Science and Technology Laboratory
DG	Directorate-General
DG ENER	Directorate-General for Energy

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DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs
DG RTD	Directorate-General for Research and Innovation
DG SANTE	Directorate-General for Health and Food Safety
EASME	Executive Agency for Small and Medium-sized Enterprises
EC	European Commission
EDA	Economic Development Administration
EEN	Enterprise Europe Network
EEPR	European Energy Programme for Recovery
EMFF	European Maritime and Fisheries Fund
ERC	Engineering Research Centers
EU	European Union
FFG	Austrian Research Promotion Agency
FP7	Seventh Framework Programme
FTI	Fast Track to Innovation
GOALI	Grant Opportunities for Academic Liaison with Industry
H2020	Horizon 2020 EU Framework Programme
INEA	Innovation and Networks Executive Agency
IPR	Intellectual Property Rights
IRG	Interdisciplinary Research Group
ITA	International Technology Alliance
IUCRC	Industry-University Cooperative Research Centers
JPI	Joint Programming Initiatives
MAST	Micro Autonomous Systems and Technology
MDF	Manufacturing Demonstration Facility
MRSEC	Materials Research Science and Engineering Centers
MS	Member States
Mtech	Maryland Technology Enterprise Institute

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NASA	National Aeronautics and Space Administration
NCAI	NIH Centers for Accelerated Innovations
NCATS	National Center for Advancing Translational Sciences
NCBiotech	North Carolina Biotechnology Center
NHLBI	National Heart, Lung, and Blood Institute
NIH	National Institutes of Health
NIS	Network and Information Science
NIST	National Institute for Standards and Technology
NNMI	National Network for Manufacturing Innovation
NOBIC	New Orleans BioInnovation Center
NSF	National Science Foundation
OIC	Office of Industry Collaboration
ORNL	Oakridge National Laboratory
OTAC	Office of Translational Alliances and Coordination
PFI:AIR-RA	Partnerships for Innovation: Accelerating Innovation Research-Research Alliance
PFI:BIC	Partnerships for Innovation: Building Innovation Capacity
PRCE	Collaborative Research Projects involving Enterprises
PRCI	International Collaborative Research Projects
REACH	Research Evaluation and Commercialisation Hubs
RDI	Research development and innovation
RIS	Regional Innovation Strategy
RTP	Research Triangle Park
SBA	Small Business Administration
SBIR	Small Business Innovation Research
SFS	Seed Fund Support
SILC	Sustainable Industry Low Carbon Scheme
SKF	Swedish Knowledge Foundation

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STI	Science, Technology and Innovation
STTR	Small Business Technology Transfer
S&T	Science and Technology
TRL	Technology Readiness Level
US	United States of America
USM	University System of Maryland

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DISSEMINATION PLAN

LINK ON THE PROJECT WEBSITE FOR DISSEMINATION:	http://www.euussciencetechnology.eu/about/results
MAIN TARGET GROUPS OF THIS DELIVERABLE	Relevant EU-US programme owners, clusters, networks, universities, private companies, research institutions and governmental institutions
WHAT IS EXPECTED AS A GOOD BENCHMARK FOR HITS ON THE WEBSITE FOR THIS ACTIVITY LINK?	At least 100 hits per year throughout the project lifetime.
HOW IS THE DELIVERABLE REACHING TO TARGET GROUP?	Dissemination channels and actions developed under the project.
WHICH CHANNELS ARE USED?	Dissemination events and workshops organised/attended under the BILAT USA 4.0 project; especially the academia-industry workshops where the deliverable will be promoted and discussed; Project website; Social media (Facebook and LinkedIn); One-on-one approach through e-mail.

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9. APPENDICES

Interview Protocol

The interview protocol below is designed to gather insights from programmes that promote or support academia-industry cooperation, including challenges and best practices. The protocol accommodates a variety of interviewees. Questions will be selected from the protocol based on the profile of the interviewee at the discretion of the interviewer.

Interviewee:
Interviewer:
Date:
Location:

This Deliverable aims at understanding mechanisms for promoting and supporting university-industry collaboration.

We would like to understand the factors that facilitate or inhibit university-industry collaboration, how organisations can successfully promote and support university-industry collaboration, and how university-industry collaborations can be improved and expanded in the future. We are also interested in promising examples of such collaboration drawn from your experience or from the experience of others. This interview should not take more than 45 minutes to complete. Do you have any question related to this project or this interview?

A. Background

1. I understand you are [position] at [organisation]. Could you briefly describe your [organisation] and its role in university-industry collaboration?
2. Can you please briefly describe what your responsibilities are and your role with regard to [organisation]'s engagement with university-industry collaboration?
3. How long have you been in your current position?

B. University-Industry Collaboration Overview

4. What benefits does the industry derive from participating in university-industry collaboration? And Universities?
5. What are the main reasons for the industry to engage in university-industry collaborations? And Universities?
6. Does the size of a company affect its interest and ability to participate in university-industry collaborations? How and why?
7. Similarly, does the size of a university affect its interest and ability to participate in university-industry collaborations? How and why?
8. What external factors promote university-industry collaboration in [region/country]?
9. What obstacles prevent stronger university-industry collaboration in [region/country]?
10. Is geography an important factor in university-industry collaboration? Is it preferable for industry to partner with universities in close proximity, or is it beneficial to partner with a geographically diverse set of universities? How is the nature of the collaboration different depending on the geographic proximity?
11. Are there specific challenges/opportunities to international university-industry partnerships in [region/country]?
12. In your experience, how have university-industry partnerships contributed to sustained economic development in [country/region/organisation]? Please mention any relevant examples.

C. Programme Structure

13. What types of university-industry collaborations does [organisation] promote or support? What are they key components/requirements of these collaborations?
14. How big is [organisation]'s budget for university-industry collaborations? And how is it allocated by type of collaboration?
15. Would you characterize [organisation] as supporting a large number of small university-industry collaborations or a small number of important/large university-industry collaborations, or a mixture of both? Which types of models are used to meet what type of objectives? How and why has this evolved over time?

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16. At which stage of business operation (ideation, RDI, marketing and sales, or post-sales) does [organisation] promote or support university-industry collaboration? Can you provide an example to illustrate?
17. Does [organisation] promote university-industry collaborations in specific geographic areas? Domestic? International? Both? Does [organisation] have different models for promoting or supporting local versus international/distant university-industry collaborations? Please describe roles and responsibilities of [organisation] in these models.
18. How does [organisation] identify industries and universities interested in participating in university-industry collaboration?
19. What is [organisation]'s process and criteria for selecting participating industries and universities? How does this differ depending on the type of collaboration?
20. What role does [organisation] play in facilitating university-industry collaboration?
21. Does [organisation] have policies or programmes to help overcome common IP issues encountered in university-industry collaborations?
22. What procedures/methodology are in place for project management at [organisation] to manage university-industry collaboration?

D. Programme monitoring and effectiveness

23. What is your impression of the effectiveness of [organisation]'s different types of university-industry collaboration programmes? What types of collaborations have been most effective in terms of meeting [organisation]'s objectives (e.g. specific RDI outcomes, recruitment of high-quality graduates, training, etc.)?
24. Does [organisation] formally evaluate the effectiveness of its university-industry collaboration programme[s]? Is there a methodology and/or governance structure to do so? What metrics/key performance indicators does [organisation] use to measure effectiveness? What aspects have you found difficult to measure/quantify?
25. What are the key barriers or inefficiencies you have observed in the initiation or management of different types of university-industry collaborations? How have these barriers been overcome?
26. When considering past university-industry collaborations supported by your programme[s], which ones have been really successful? Why were they successful? Do you have a sense of what factors were important in generating success?
27. Taking a step back, what are the overall best practices in university-industry collaboration that you have seen, whether at [organisation] or elsewhere? How would you improve [organisation]'s university-industry collaboration programme?
28. Do you know of other organisations that run notably successful programmes that promote or support university-industry collaboration? Do you know any successful programmes that specifically target collaboration between the EU and US?
29. What opportunities for future university-industry collaboration in [country/region/organisation]?

E. Conclusions

30. Can you recommend anyone else we should talk to who has in-depth knowledge of university-industry collaborations?
31. Are there any questions that we did not ask that we should have asked?

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List of Interviewees

Name	Programme / Organisation	Position
Bernd Reichert	H2020 - EASME	Head of Unit, European Executive Agency for SMEs
Nicholas Deliyanakis	H2020	Deputy Head of Unit, Industrial Technologies, DG Research & Innovation
Luis Vieira	Portugal Ventures	Executive Vice President
Klaus Wefelmeier	German Research Foundation	Head of the Engineering Sciences Division
Jean-Michel Roux	French National Research Agency	Deputy Head of Department, "Carnot" Programme Officer, Investments for the future and Competitiveness Department
Ulf Hall	Swedish Knowledge Foundation	Head of External Relations and Communication
Joakim Appelquist	VINNOVA	Director, Head of International Division
Alan Haigh	INEA	Head of the Horizon 2020 Department in INEA
Karel Kucera	CzechInvest	CEO
Andrzej Rys	DG Sante	Health systems, medical products and innovation Director

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